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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

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IT should be known to our readers that the Science and Art Department at South Kensington has introduced into its list the subject of hygiene. Examinations will be held upon hygiene about the same time in the year as those connected with the other subjects which are in the list published by the Department.

We are of opinion that this is an important step in the right direction; that grants from the State exchequer for this purpose will be repaid to the country a thousandfold if it leads to the popularisation of the truth regarding the general health of the people. To assist this object, and to place in the hands of the teachers of the country a means whereby they may prepare students for this examination, we propose to supplement the work which has been already done in that direction by some further instructions upon '*General Hygiene.*' If our readers will refer to the observations which have been made in '*School Hygiene*,' '*School Surgery*,' and the '*Teacher's Health*,' and follow them up by carefully considering the additions which will be supplemented in this and the succeeding numbers, there will be information sufficient to enable students who can fairly grasp the subjects treated of, to pass the examination with credit to themselves and their school. It should be known that no payments will be made upon the results of the instruction of pupils in this subject who have not passed the examinations of the Department in Animal Physiology.

We propose to consider *seriatim* the main points in general 'hygiene' which have been omitted from former volumes, and which are put forth in the syllabus which has been issued by the Department as necessary for candidates to know. We propose to take them somewhat in the following order:—

(1) *Food and its Adulterations*, including classification; economical and wasteful diets, and calculations of diets, etc.

(2) *Water and Beverages.*—This will include different kinds of waters; sources of contamination; filters, constant and intermittent service; fermented and unfermented drinks; aerated waters and other beverages, such as tea, coffee, cocoa, etc., etc.

(3) *Examination of Air.*—Microscopical and chemical; the general changes which take place in air consequent upon meteorological conditions; its deleterious conditions; the quantity required for each person, etc.

(4) *Removal of Waste and Impurities.*—Principles of ventilation, natural and artificial; antiseptics, deodorisers; cesspools, main sewers, traps, dry and wet methods of removal of sewage, etc., etc.

(5) *Shelter and Warming.*—Sufficiency for all; injurious clothing and modes of dressing; poisonous dyes; materials for construction of walls and roofs; foundations, floors, dangerous papers and other wall coverings; fireplaces, stoves, and grates, smoke abatement, products of combustion, radiation, warming by hot air and water, etc.

(6) *Local Meteorological Conditions.*—Elevation, wind, rain, moisture, ozone, etc.

(7) *Personal Hygiene.*—Influence of age, sex, temperament, idiosyncrasy, heredity, etc.

(8) *Prevention of Disease.*—Consumption, scrofula, rickets, rheumatic fever, marsh diseases, endemics, epidemics, etc.

(9) *Nuisances.*

(10) *Vital Statistics.*

(11) *Sanitary Laws*, etc., etc.

In each of these subjects reference will be made to the best books which have been published for further information, so that a student anxious to go deeper into the study of each may be directed to the best sources of instruction with the least loss of time. In this way we hope to lay the foundation for a true knowledge of hygienic laws, by which the health of the people may be materially aided, and a great stride made towards the removal of disease from among the masses. It cannot be too generally known that nine-tenths of the common ailments to which people are daily subject are not absolute diseases, but are functional derangements consequent upon an interference with the proper and uncontaminated supply of air, water, or food, or else to a non-removal of *débris* from the curtilage of the body itself, or from its immediate neighbourhood. The resulting contaminations produce functional disturbances; nature rebels at the treatment to which the body is subject, and an explosion takes place; the intruding contamination or its result

BRITISH MUSEUM

is expelled, and the corporeal atmosphere purified. If these functional disturbances are of frequent occurrence, organic disease of one or more of the organs most generally implicated eventually arises; the individual becomes a confirmed invalid, and the whole community suffers more or less in consequence.

It will be shown in the chapter upon vital statistics how the incidence of disease affects the interests of the public generally. I will only just refer at this point of my work to the fact that there are large establishments in the country, in which children are brought up in general obedience to sanitary law, the inmates being orphans, or those having been deserted by their parents, or are the children of diseased people who cannot work for the support of their offspring, and in whom poverty and depraved habits have led to the production of much hereditary evil. In these establishments the mortality is not more than 2·5 per 1000, and fatal epidemics are almost unknown; whilst in other districts where the masses are crowded together, and hygienic laws disregarded, the mortality equals 40 to 50 per 1000, and scarcely half the children born attain to the age of five years. This single fact tells its own story, and proves how great must be the incidence of preventable diseases among the people.

This incidence is promoted by two distinct causes. First, the ignorance of the masses themselves respecting general hygiene, which ignorance leads them to ignore the evil effects of foul air, foul water, and adulterated and decomposing food, etc., etc., and of the consequent sloth and intemperance which results from and belongs to this state of ignorance. Secondly, the want of knowledge on the part of the persons appointed to remedy the evils which arise from the absence of proper drainage and water supply, and of other mischiefs which it is the duty of the municipal authority to prevent or remedy. The syllabus provided by the Science and Art Department at South Kensington will, if pressed by teachers upon the attention of the advanced pupils in the higher and even in elementary schools, do much to check the incidence of disease in general by providing a lever of knowledge upon all the foregoing points, whilst those who aspire to the offices of Inspectors of Nuisances and Local Surveyors to Sanitary Boards and Sanitary Aid Committees, ought to possess a good general knowledge upon sanitary subjects such as the syllabus provides. I would therefore impress upon teachers the duty of bringing this subject to the notice of their classes, and ask them to point out the advantages which will accrue to those who are seeking employment in the sanitary field, and the great benefit which will result from all candidates for office, if they not only obtain the certificate of the Science and Art Department upon this subject, but also present themselves for examination to the *Sanitary Institute of Great Britain.* This Institute grants diplomas to its successful candidates, and enrols them as Associates of the Institute. The position is one which it is very desirable that sanitary officers should possess, because it brings them into direct relationship with the first sanitarians of the day, and entitles them to the publications of the Institute, and to the privileges of the 'Parkes Museum.' This latter is an educational exhibition of the best sanitary appliances of the time; it was founded in memory of the late Dr. Parkes. It is at present established at 74a, Margaret Street, and to it the Associates of the Institute of Great Britain have free access. They can there study the apparatus which is best fitted for sanitary work, see for themselves the best sanitary appliances in action, and get information as to the successful competitions at the various sanitary exhibitions which are held almost every year in connection with the Congress of the Sanitary Institute.

I press the point of examination in hygiene upon the attention of my readers, because I believe that those who follow the lead thus pointed out will show themselves to be philanthropists in the real sense of the word, the distribution of benevolence without regard to sanitary knowledge having a tendency to pauperise the people.

How much evil has been done under the guise of philanthropy and benevolence! People have become shiftless because the necessity for exertion has not been allowed to exist long enough to call forth the powers of resistanoe which are dormant in the system, and have, therefore, remained undeveloped. Self-reliance is decreased in each individual, until a mass of helplessness results, which, when there is sudden occasion for exertion in the presence of dangerous epidemics or other diseases, leads to panic and all its horrible consequences. The cry is, something must be done, when a little common sense, foresight, and prudence would have averted the necessity for sudden energy, which is nearly always exerted in a wrong direction. A study of the laws of hygiene, if they be put into operation, does more to promote thrift and self-reliance, and to combat pauperism and crime, than any other study, not even excepting the principles of religion, because benevolence uncontrolled by strict justice does an immense amount of evil in the world, with which result obedience to hygienic law cannot be charged. Hygiene does not allow of the dogma of doing evil that good may come, whilst it inculcates the duty of considering our neighbour's interests equally with our own; and as cleanliness is next to godliness, it appears to me that they are in reality identical, and almost convertible terms, and that the latter cannot be truly followed unless the former is scrupulously obeyed. With these observations I commend hygiene to the study of my fellow-men, as based upon the true principles of piety and justice to all.

FOOD.

Food is taken for various reasons. We obtain 'force' out of food; animal warmth is produced by its agency, so are nerve energy, mechanical motion, vitality. These powers are all the consequences of actions which are kept up by food. Grove, in his 'Correlation of Physical Force,' has shown us how light, heat, electrical action, motion, and chemical affinity are convertible the one into the other, and Mayer gave us right views upon the 'Conservation of Force,' whilst Mr. Joule assessed it at a value by which all the imponderable agents dealt with by Mr. Grove, are brought into comparison with an equivalent. He shows us that a fall of 772 pounds of water from a height of one foot, gives an amount of heat sufficient to elevate the temperature of one pound of water to the extent of one degree Fahrenheit, or conversely the fall of one pound of water from a height of 772 feet produces the same result. We are able to assess the dynamic power of individual foods, to show how they act in conserving the force which they may contain, and to point out which are the best for special purposes or the special wants of the body.

It is true that in the living body there are influences at work which do not exist in non-living matter. It has been supposed that physical force may be overruled by the vital principle, but whether this is so or not, it is not antagonistic to the principle of that conservation of energy which evidently does take place in the construction of the human body, and which conservation is a part of the process always more or less in operation in the body in connection with the assimilation of food.

The force evolved by muscular action is derived from the material which has been taken in as food. This is mainly obtained from the vegetable kingdom in the first instance, and is produced by the conserved force of the sun's rays. The oxidation of those materials allows the 'conserved force' to manifest its presence by 'potential or actual energy,' according as this oxidation goes on, slowly or rapidly, whether by simple means or by the compound actions which are operating in a thousand different ways. So we have actual and immediate results produced, or supplies are rendered 'latent,' ready at hand as occasion may arise for the production of the various attributes and functions which are proper to the animal frame.

Life implies constant, incessant change. Oxidation implies waste, and waste products must be removed. Thus we have to consider the nature of food with especial reference to its waste products. The ingesta have a value according as the egesta are great or small, just as an ore is valuable according to the percentage of good metal which it contains; so, conversely, food is valuable according to the greater or less amount of *debris* which results from its use. We must therefore consider the constituent elements which food contains, and choose those which can best satisfy the requirements of life.

The most essential elements are carbon, hydrogen, oxygen, and nitrogen; then sulphur, phosphorus, chlorine, silicon, and the alkalies, and alkaline earths, with minute traces of some of the metals, as iron, manganese, etc. These are the main constituents of 'Alimentary Substances.'

These elements have been brought into combination by the agency of living organism, and cannot be produced by simple chemical agency, but they all contain certain alimentary principles, which give the value to each, and upon which classification depends.

(To be continued.)

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Friedrich Fröbel.

BY HIS PUPIL, HEINRICH HOFFMAN.

VIII.

That same loving hand which amidst the roar of cannon had united the three young men in close friendship, took good care that no vicissitudes of life should undo a work which was destined for a great future. Soon after the war they met again in Berlin, Middendorf and Langethal being both engaged as private tutors. Middendorf, who felt his whole being irresistibly drawn towards Fröbel, was for a time his fellow-lodger, and Langethal joined him in earnest studies of educational subjects under their respected guide and friend, whilst the hearts of the three were drawn closer and closer to each other.

However, in 1815 the trumpet again summoned all Germany to arms. The united friends once more tendered their services; but as the applications were so numerous, all public officers and all members of the teaching profession were exempted. That 'still, small voice' within him became louder and more imperative, and so, in consequence of a letter he received, Fröbel resigned his office, and left Berlin on the first of October, 1816. Why and whither nobody knew; he only left word with his friends that they should hear from him as soon as he could tell them of anything definite.

The battle of Leipzig had filled to overcrowding all the hospitals available. Fröbel's favourite brother Christoph, the minister of Griesheim, a small village near Ilmenau, had fallen a victim to typhus fever during his philanthropic labours among the unfortunate sufferers. The letter referred to was from his widow, who asked for advice and assistance in the education of her three sons. Such an appeal was irresistible, and at once matured his long-cherished plans.

Of course he first repaired to his brother Christian, the weaver in Osterode, to devise with him the plan of his new undertaking. Christian entertained a very high opinion of his brother; he had always taken great interest in his educational schemes; and had eagerly entered into all the details of his life with Pestalozzi. Fröbel's offer to devote himself entirely to the education of his nephews, and to begin his long-prepared work with such a labour of piety, was gladly accepted, and to mark his own sense of confidence and esteem, Christian put two of his own children also under his brother's care.

November 13th, 1816, may be noted as the day when Fröbel entered upon his own independent labours at Griesheim. He now summoned to his assistance Middendorf, who at once relinquished his design of taking holy orders, and joined his beloved and respected friend, by whom he was as it were spell-bound. Fröbel was to him all in all.

The two men were very different in their natural dispositions. Fröbel was all choleric fire, quick in temper, passionate in whatever he took in hand; Middendorf was always calm, gentle, a man of womanly tenderness, all feeling, all sympathy with his fellow-men, a very Saint John in character. Fröbel had an eye pensive, reflecting, scrutinizing, and, as it were, looking inward; Middendorf's eye was bright, clear, beaming with kindness, faithfully portraying his childlike mind. Fröbel's impulsive nature often blinded him as to men and matters. Enthusiastic at once, he would entertain the most extravagant expectations in regard to men and things, such as could never be satisfied; and then, on seeing his error, would fall into the other extreme of despair when there was little need to do so. It was Middendorf's part to judge calmly and justly, and to smooth down with kind and tender hands any roughness, any unpleasantness which his friend might have caused.

Like Luther and Melancthon, these friends were the complementary opposites each of the other. They found their common bond in their love for children, for mankind, for God, and in their self-denying devotion to the divine idea which had such entire possession of them. Fröbel was the creative, the inventive genius; but the gift of clear, lucid utterance was denied him. Middendorf was his mouthpiece—an orator whose clear, warm-hearted, poetical diction nobody could resist. The melodious tones of his voice, the noble fire of his

eye, the true portraiture of his whole inner being, the inexpressible charm of thorough conviction, of honest truth, of a rapturous love for little children, and, moreover, all this hallowed by pious modesty, by almost maiden-like bashfulness and simplicity, gave to all who heard him a never-to-be-forgotten treasure of high enjoyment. Fröbel required longer time and deeper study to be fully appreciated and admired. At first sight, any observer would be conscious that he was in the presence of an extraordinary and peculiar character. There was something about him that either filled people with awe and wonder, or caused them to laugh, and to think him eccentric and irritable. Indefatigable in his perorations, grand in his high-flown language, with eyes closed, as if they were needed to read inwardly, he was apt to entangle himself in a mass of explanatory synonyms which required the strictest attention of his listeners to unravel. But all who persevered soon felt fascinated, and found their faith in him more than justified. They could not fail to be deeply struck with high admiration of the noble, self-denying philanthropy that animated the man. One felt oneself in the presence, not so much of a professional man, as of a sublime idea embodied in human form. To the young, Fröbel was indeed the revered teacher; they looked upon him with awe and reverence: but Middendorf was their own intimate friend, their associate, who knew how to throw an irresistible poetical charm, a childlike happiness about everything he touched upon. It was just such a man that Fröbel stood in need of. Nor was it an easy task to co-operate with him; it required an amount of gentle patience, of self-forgetting humility, not frequently found. His immovable conviction that he was the bearer, the servant of an infallible divine idea, made him impatient of contradiction. Of his friends he expected not only the same restless ardour which animated himself, but unconditional concurrence with and submission to everything he ordained. In 1829 he states accordingly: 'I look upon my labours and my aspirations as an unparalleled phenomenon of our time, as indispensable and salutary for all times, as offering to mankind all that it requires and longs for in every respect. I have no objection if others think otherwise. I can bear them, I can even—and I have given proof of this—live with them. Only I cannot have in common with them one and the same aim of life. But that is not my fault, it is theirs; I do not discard them, it is they who discard me.'

(To be continued.)

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Lessons in English.

BY ALEXANDER BAIN, LL.D.,

Author of "Education as a Science."

III.—The Definition of Poetry.

We have already considered some of the ways of confounding Poetry proper with other departments, as Science, Eloquence, Morality, Religion, and have endeavoured to draw the line in each case. At the risk of some repetition, we must now survey the wide field of questions growing out of the fact that Poetry is not self-dependent, but must have a subject. This is the one main reason why it so easily passes into other provinces: assuming to be, at one time, science; at another time oratory, and so on; professing to be poetry all the while. The arts peculiar to the poet—his images and fancies, his exquisite groupings and harmonies—cannot subsist entirely apart.

The most frequent of all poetic subjects is Narrative, or Story: the ongoings of our own kindred; *quidquid agunt homines.* Now, to narrate is an art by itself: it follows laws of its own, and involves skill in the narrator. We may have a plain narrative well told from the historian's point of view; we may have the same subject poetically adorned; the poet being now narrator and poet in one. It does not follow that the properly narrative part is well done, because it is converted into poetry: although the poet is easily led to suppose that he is as good in narrative proper, as he may be in poetical ornament.

But this is not the worst snare to be encountered. A narrative subject may have an independent interest of the very kind that the poetic art in its purest examples delights to afford. The feelings of sublimity and pathos are pre-eminently feelings belonging to Art, and, if they can be produced by a composition devoid of poetical adornment, they are still welcome. Now, many narratives inspire such feelings, although so bald and simple, as not to be confounded with poetry in the smallest degree. The remark was made by Sir G. Cornewall Lewis that the account of the battle of Marathon could not be perused for the hundredth time without emotion. So grand and inspiring was the barest relation of the incidents, that nothing more was needed to fill the mind with the sublime of heroism and devotion. Now, these are the very sentiments whose production would be regarded as a triumph of art. Nevertheless, the poetical treatment was superadded. In the Grecian Drama, as, for example, the *Persæ* of Æschylus, poetic genius was employed to intensify the emotions that the mere history would never fail to awaken in after ages.

If a second example is necessary, Greece can furnish it. In one of the speeches of Lysias, we have the recital of the heroic attitude of Socrates in confronting the Thirty Tyrants; and in the *Memorabilia* of Xenophon we learn how he stood out against the popular assembly, when urged, as Prytanis, to put an unconstitutional question to the vote. In both instances we have the moral sublime in a naked recital of the facts. The opening stanza of a well-known Ode of Horace (without apparently having Socrates in view) poetizes both situations with the felicitous brevity of the poet.

> Justum et tenacem propositi virum
> Non civium ardor prava jubentium,
> Non vultus instantis tyranni
> Mente quatit solida.
>
> The man of firm and righteous will,
> No rabble, clamorous for the wrong,
> No tyrant's brow, whose frown may kill,
> Can shake the strength that makes him strong:
> *Conington.*

It is needless to multiply examples. Every heroic or noble action, every heroic personage, can be described in unadorned, and also in adorned, language. The emotion is intensified by the adornment, but not created. It is easy for a poet, in such circumstances, to remit his poetical handling, and to rest satisfied with the fact that the emotional effects are not remitted; the subject being operative by its unaided

influence. Compare the French Revolution as treated in prosaic style, with Carlyle's treatment. Take also the Roman traditions worked up in Macaulay's *Lays*, and compare the one form with the other.

This last consideration will help us to understand Wordsworth's vacillation as to the nature of poetry. He lighted upon matters of fact so intensely emotional, that poetic handling seemed to be dispensed with, as scarcely contributing anything to the effect. He always observed the metrical form, which is of itself of the nature of poetry; he also used the choicest of the ordinary words that the language afforded for the expression of the fact: very often he did no more. He did not deceive himself into mistaking a lifeless, for a stirring composition. There was still enough to rouse the intended emotion, and to do this was, in his judgment, to be poetical. Take as an example the odes on "Lucy." There are stanzas heightened by poetic arts; others are entirely bald and unadorned, yet not flat or devoid of effect. There is profound pathos, without a particle of poetic elevation beyond the metre, in the lines—

> She lived unknown, and few could know
> When Lucy ceased to be;
> But she is in her grave, and, oh,
> The difference to me!

The objection to such writing is, not that it does not move us, but that it appears within the reach of any one without being a poet. Quite different is the verse immediately preceding—

> A violet by a mossy stone,
> Half hidden from the eye!
> Fair as a star, when only one
> Is shining in the sky.

Comment upon this is unnecessary.

To take another short example, "Thoughts too deep for tears," is a memorable stroke of felicitous expression; "thoughts that drew forth tears" is too perfectly hacknied and easy, although in the circumstances, pathetic.

The greatest poets of antiquity were fully conscious of the difference between interest independent of their treatment, and what was their duty as artists. Virgil and Horace chose interesting subjects; yet they knew what was requisite besides in order to form poetry. In the "Georgics," Virgil never omits an ornamental phrase (Simcox's "Latin Literature," I. 263).

A poet cannot be giving birth to felicities of expression in every line; he must at times descend to the level of good ordinary diction, while his readers have to be satisfied with the interest of the thought; yet he must not throw upon his subject, whatever that may be, the whole burden of keeping up the charm.

There still remains an important observation carrying us into the very depths of art. The poetic narrator may appear to be using language not a whit more elevated than an unpoetical historian. Nevertheless, there is something in the poet's way of bringing forward the facts that we do not find in the other. Allow that Wordsworth often gives us pages without a stroke that Mr. Austin would call "transfiguration," he yet tells a story remarkably well. What interest is in it he brings out, not merely by well-chosen, although common expressions, but by his manner of selecting and arranging the incidents. This is the merit that of all others is very difficult to make apparent. The reader is satisfied with the effect without knowing how it comes. He does not, for example, know that the poet's delicate judgment has made omissions that would not have been made by a narrator devoid of the poetical sense. Before we say of a poet, as Jeffrey of Wordsworth, "This will never do," simply on the ground that he has too seldom ascended the brightest heaven of poetical invention, we must judge of the power of his story as due to selection of circumstances.

A good illustration of the point is supplied by the peculiarly poetic interest of Plot. A historian gives us this interest without thinking of it; his narrative contains it whether he will or not. An artistic narrator develops the interest by studying its conditions, and by suiting the choice and sequence of the facts to these conditions. Hence it is from a Walter Scott, or a Wilkie Collins, and not from an ordinary historian, that we obtain this mode of pleasure at its best.

Another example may be taken from the unfolding and mutual action of character in the Epic and the Drama. Several whole books of Homer are devoid of similes, which are Homer's great instruments of transfiguration. Nevertheless, these books receive the highest praise for other characteristics distinguishing the poet from the mere narrator.

The poet finds occasionally that the action can be made so animated and diversified that other interest is unnecessary (Gladstone's "Homer," p. 150). Yet in this we may trace a poet's hand—a power that a mere annalist could not put forth. Selection, omission, and disposition of parts, are as vital to poetry as verbal ornament. The critic has no easy task in disclosing the secrets of this branch of the poetic art. Only the poet himself could tell us all his trials and rejections; the critic or the teacher, when dealing with a consummate artist, needs to imagine what an inferior composer would have done; they can work to advantage only with an artist that mixes defects with his merits.

At a later stage, we shall have to consider the import of the term "Ideality," as applied to Poetry and Art, which will be an opportunity for making the foregoing remarks somewhat more telling.

To pass from narrative to another frequent theme of poetry—the Description of external nature. The geographer, topographer, naturalist, are rivals in this undertaking. And a great geographer, like Humboldt, describing the grandeurs of natural scenery, produces upon the minds of his readers the emotions most proper to art; emotions so genuinely artistic, that the artist desires nothing beyond. Yet a poet, to be a poet, must do something more. Happy in the intrinsic force of his subject, he must impart an additional charm from his own special handling. He may occasionally pause, and relieve the strain of invention, by falling to the level of a geographer who merely wields the common unadorned style. The greatness of the subject will tide him over short intervals of flatness of expression; but he must not forget himself too long. As remarked under Narrative, he may be exercising the less obtrusive devices of his art; the careful selection and omission of descriptive circumstances, rendering his composition effective without brilliant or distinguishing strokes of the transfiguring kind.

Leigh Hunt furnishes an apposite example from Natural History, in the treatment of the lily. A gardener and a botanist would each describe it in their

own terms, which would be perfectly plain and prosaical, but yet reflecting the intrinsic interest of the subject. The poet might adopt these, and be content. Poets have not stopped at this point. With Spenser, it is the 'lady' of the garden; with Ben Jonson—

> The plant and flower of *light*.

Let us pass next to the adoption of Doctrinal truth as a poetic subject. This includes not simply hard science in its technical and rigid dress, but also doctrinal views of the more popular kind in all matters that interest the ordinary mind. Enough has been said on the contrast of poetry and science strictly so-called; but the illustration of the points already brought forward needs to be carried a little further.

We find in the writings of critics such remarks as these:—"Truth of every kind belongs to the poet, provided it can bud into any kind of beauty" (Leigh Hunt). A great poet, whatever his ideas may be, must work "under the conditions immutably fixed by the laws of poetic beauty and poetic truth" (Mr. Arnold). The general principle is incontestable, but the applications are not always free from difficulty.

There is first the question as to the kind of truth that readily lends itself to poetic handling. Here, as in narrative, the poet likes to have a subject that has a sustaining interest of its own, so as to carry the reader forward when the poetic aids are intermitted. This does not apply to all kinds of truth. Moreover, some truths are even repugnant to the emotions of poetry: their value lying in their useful applications, and not in their æsthetic interest. Political economy has been called a "dismal" science, because its doctrines are unpalatable in the statement, however valuable as guidance. Thomas Campbell regards the optical explanation of the rainbow as anti-poetical. On the other hand, the grandeurs of Astronomy are half way to poetry, before the poet puts his hand to them.

The poet and the scientific man cannot travel long together. Science to fulfil its vocation must be precise; this needs limitations, qualifications, and, often, numerical statements, which freeze up poetry. Plato is said to have given a poetical philosophy, but when he was most scientific he abandoned the poetic dress. It is in the less exact departments of science, as Ethics, Politics, Æsthetics, that least resistance is offered to the poetic handling. There are also practical sciences of great human interest, and for this reason are they seized hold of in poetry.

A worse incompatibility remains. The poet, when he finds a truth not to his liking, forthwith derides, evades, or perverts it. If the scientific man remonstrates, he is called a "black-browed sophist," he is "foul with sin" (Tennyson); he is denounced as capable of "botanising on a mother's grave" (Wordsworth). The fallacy of the Stoics that—"There is nothing either good or bad, but thinking makes it so," finds favour with our poets. In the zeal to make the external world more poetical, even the stars are tampered with; the fiction of sphere music is adopted and improved upon, until we reach the gorgeous Shakespearian lines—

> "Not a star that thou beholdest...."

Excepting as a bad example, this does no harm.

Tennyson's attempts to disparage Geology by his poetic indignation may be seen in *In Memoriam*, 119, 123.

Leigh Hunt tells us:—"A true poet is by nature a metaphysician; far greater in general than metaphysicians professed. He feels instinctively what the others get at by long standing." To laud the power of instinct is a most agreeable flattery; it relieves us from the pains of laborious research.

The kind of science or doctrine that plays the greatest part as a subject of poetry is what bears upon human life in its manifold aspects—upon politics, morality, and the theory of right living. Political saws are very frequent matter for poetic allusion. They abound in our great poets from Shakespeare to Tennyson. The proper relations of ruler and subjects, the duties and the rights of each, frequently come up in connection with epic and dramatic themes. These have an interest in themselves, from their relation to human well-being; and a poet may trust to their aid for carrying the reader on, while his art is in abeyance.

It is easy to pronounce on what occasions they are properly admitted into poetry; whether they are shaped for poetical effect, and whether or not they are assisted by the poet's own art. There is poetry in the lines of Goldsmith—

> Ill fares the land, to hastening ills a prey,
> Where wealth accumulates, and men decay—
> Princes and lords may flourish, or may fade—
> A breath can make them, as a breath has made:
> But a bold peasantry, their country's pride,
> When once destroyed, can never be supplied.

This is a welcome sentiment, poetically expressed. The inferior orders of society are pleased and flattered to be told of the flimsy tenure of "princes and lords"; although very little discernment is necessary to show its want of truth. Much more than a breath is necessary to make princes and lords.

Tennyson also abounds in political commonplaces, often exquisitely touched, but without being made more scientifically true.

More usual still is it for poets to introduce Morality, or the principles of moral right and wrong, to enhance the interest and the worth of their compositions. This is perfectly admissible, on the understanding that the morality is not the poetry; although the union of the two makes a highly meritorious work; just as the union of poetry and abstract science would be, if, as can seldom happen, the two were reconcileable. A poet that can carry along with him an intensely interesting subject, and give it a full poetical treatment, is necessarily greater than one that bestows the same degree of poetic force on a neutral or indifferent subject.

The first and simplest of moral applications is to deal out justice to persons according to the received moral standard. The ordinary novelist must do this to be tolerated. It belongs to the art of pleasing the audience addressed. It was incumbent on Homer, so far as his story allowed. Scott is a master of the proprieties of poetic justice.

A poet may take a higher flight, and make his poem purposely moral: that is, he may shape his characters and incidents with the express view of setting forth the punishment of vice and the reward of virtue. This was exemplified in many of the ancient tragedies; the greatest modern instance is Dante. Such works are not simple poems: they are more or less successful combinations of moral preaching with poetry, neither of which attains perfection under such a plan. The compound is fascinating from the circumstance,

already adverted to, that a poetical morality is not intended for practice.

The poet's loftiest aim, in connection with moral good and evil, is to "vindicate the ways of God to man," to grapple with the anomalies of good men made to suffer and bad men triumphant. In adopting incidents from actual life, such difficulties are not to be glossed over by the idealising process. This was the theme of the ancient tragedy, and has drawn forth the most powerful strains of poetic inspiration and originality. Apart from such a splendid result, it would scarcely be a proper subject for poetry: it deviates too far from the condition of being agreeable. Had Shakespeare, however, never grappled with tragic themes, we should not have known the compass of his genius. Nevertheless, these subjects must be considered exceptional; they should be chosen only because of the poetic merits that they give birth to. The fascination of suffering must not be carried far; the indulgence is degrading to human nature. All literatures are full of the abuse of the license. The treatment of the problem of evil, by Milton and by Pope, is too argumentative for poetry; it is more on the level of the theological chair.

Different from all these modes of introducing moral themes, although freely intermingling with them, is the employment of poetry as Life-guidance, and "Life-criticism," a phrase invented by Mr. Matthew Arnold, and given by him, with certain limitations, as a definition of poetry. That Life-criticism is not the essence, but a valuable adjunct of poetry, and a characteristic of certain poets, for example, Wordsworth, has been abundantly shown by Mr. Austin. But, indeed, we need to study carefully the exemplary instances, in order to know what the phrase exactly means, for, like many other general words applied for the purpose of a definition of poetry, it has a variety of senses.

One meaning of the phrase is given by its author—"How to live." To teach the art of living well is a vast function, requiring immense knowledge of human nature and human life. Now, it would seem proper that whoever aspires to this great undertaking should be disenthralled from the conditions of poetic form, and should give his whole mind to making his directions just and clear. In point of fact, however, the poet has never done more than adopt the received formulas of right living, and put them in an attractive dress. He avails himself of the interest attaching to the great question of how to live, and merely superadds his own treatment to enhance what he does not create. If we were anxious for more specific and literal directions as to the conduct of life than are furnished by the old common-places; if we wanted some clear rules to go by, we should gladly dispense with the poetic dress (which is the enemy of precision) and prefer a style as bald as Euclid's, and as technical as Jeremy Bentham's. No man would steer a ship round Cape Horn and across the Pacific upon a poetical guide to navigation. But let us see a characteristic example of Wordsworth's Life-guidance:

> Of truth, of grandeur, beauty, love and hope,
> And melancholy fear subdued by faith,
> Of blessed consolations in distress,
> Of moral strength and intellectual power,
> Of joy in widest commonalty spread.

This is noble phraseology, and lifts the imagination above the vulgar routine of life. The first line is a series of qualities to aim at; but they must be viewed emotionally rather than intellectually. "Truth" in the mind of the poet is quite different from truth in science or in practice. "Grandeur" and "beauty" are the distinctive qualities of all art. "Love" is a poet's favourite subject, owing to its intrinsic charm. The idea of "Hope" always captivates us. There is a cumulative charm in the entire collocation; but there is neither direction nor instruction to be obtained from it.

The second and third lines express a high function of poetry, for which mankind will never cease to be grateful. It is the most notable of all the functions included under the vague designation "Life-criticism," or "How to live." "Melancholy fear subdued by faith, and blessed consolations in distress" express one of the perennial wants of human life. It is not exactly telling us how to live; although indirectly affording us assistance in right living.

If we lose sight of the fact that Art in general and Poetry in particular are meant to impart pleasure, as their primary end, we fall into endless confusion. There is, however, a bad association with the name "pleasure" that makes us wish to disconnect it from the noble vocation of the poet. But we have not the like objection to be relieved from melancholy and distress; nevertheless, this can be done only by the same arts that contribute to heighten our enjoyment, when we are already in some degree happy. To make the distressed more so, and to plunge the happy or the neutral into distress, would not be a good work. Far better than Life-criticism or Life-guidance would be a definition of poetry that took the two lines above quoted for the key-note. Poetry, whether or not it criticises life, should use its peculiar resources to make us less miserable or more joyous. As relief in depression, as consolation in sorrow, as an antidote to the ills of life, poetry has been welcomed since it first began. What would be the worth of grandeur or beauty, were it not to make life more endurable and more buoyant? If the poet performs any other function at the same time; if he instructs us in the laws of things; if he directs our paths when we are in difficulty,—all these are superadded functions, and must not displace the primary requisite of contributing to our enjoyment or lessening our misery.

We recognise, then, the general fact, that Poetry, as a Fine Art, is pain-allaying and pleasure-imparting. By what innumerable devices it accomplishes this high vocation, the entire compass of Rhetoric alone can tell. But with a view to the settlement of the disputed border-land of poetry and life-guidance, we need to remark that poetry has certain specific ways of operating, and takes more especially in hand a certain class of pains to be alleviated. First, however, let us complete the comment on Wordsworth's lines. The fourth—"Of moral strength and intellectual power"—is not suggestive of anything peculiar. The novel point lies in the fifth:—"Of joy in widest commonalty spread." Here we have a very notable moral idea—the finding of our pleasure in the pleasure of others. It does not directly imply self-sacrifice, but it involves a regard to the welfare of a wide-surrounding circle. If poetry is able to help in this object, it is more than pleasure-giving, or than distress-alleviating; it fosters social duty, which is what the moral teacher in all ages has been striving to accomplish. So vital is this operation, that we excuse any man, whatever his principal function may be, for stepping aside even from that

function, if he can promote the other. Yet it is by no means the express duty of the poet; and is not accounted so by poets generally. Fine Art pleasures in general have one ennobling distinction, that they can be enjoyed by mankind generally, and are not monopolised and exhausted by a few, as is the case with some pleasures. This circumstance is connected with the very material of Art, and is not due to any intention on the part of the artist.

To return now to the main function of poetry, the contributing to our joys, and the alleviating of our griefs. We need not even summarise the means of bringing about these ends; it is enough to advert to the most paradoxical of these, namely, the employment of subjects absolutely painful. Many of Wordsworth's narrative poems are tragical, not to say harrowing; while they seldom rise to the heights of tragic art, and are not redeemed by anything in the treatment. One justification might be given, on the purely moral ground. He might say that it was good for us to have our sympathies awakened towards human distress, instead of being wrapped up in our own comfort and immunity. Now a poet may, undoubtedly, undertake this work, but it is not a poetical duty, and will not be a substitute for poetical arts. A more relevant apology is this. In deep sorrow, it is better to go into the house of sorrow than into the house of rejoicing; and the salutary effect is more likely to be produced by a poetic handling of misery, than by a too literal picture. The heroism of endurance, the solution of moral difficulties, and all the circumstances that attract us to a tale of calamity, can be effectively embodied in a work of poetic genius; nevertheless, the genius is essential.

As to moralising generally, this is the professional work of the preacher alone. All of us are bound to contribute, according to our opportunities, to make mankind better. Any special claim upon the poet in this respect, is owing to the fact that he has more influence than other men; and that, in his search for themes of intrinsic charm, he often falls upon subjects having ethical bearings. If, then, it be the duty of men generally to take the benevolent, instead of the malevolent, attitude, towards each other; it is still more the duty of those in positions of influence, as poets undoubtedly are. From the unfortunate propensity of human beings to delight in malignity, a large amount of poetry is devoted to satire and vituperation. Many writers are occupied with exploring the weaknesses and vices of their fellow-men, without doing anything to reform them. Now, as a maxim, not of poetical criticism simply, but of universal duty, we are led to commend Coleridge for his professed "habit of wishing to discover the good and the beautiful in all that meets and surrounds me." If any one is competent to represent humanity and life in its severest and most literal truth, it is a man of science. Only an approximation to truth can be made by a man of language; and as the poet always mingles his feelings with his subject, we should wish him to incline to the amiable side. This may not make him more or less of a poet as such; the highest and most consummate genius may be found on the other side; but as the author of a mixed composition, where poetry is one part and doctrine another, the value of the doctrine must enter into the merits of his work. The malevolent temper of Pope and of Byron may not have detracted from their poetic force. Possibly if they had assumed a more amiable turn, their invention would not have answered so well to that stimulus. Their harsh views simply abate from their worth as teachers altogether. On the other hand, the claim may be made for Shakespeare that he holds a middle course between the extremes of sentimentality and malignity.

(*To be continued.*)

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The Discipline of the Mind.

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I.—INTRODUCTION.

THAT the foundation of the science and art of education must be laid in Psychology is one of those vital truths which obtain only tardy recognition, because an earlier perception of their importance would have been attended by no practical result. The discernment of law in Mind is an achievement of yesterday, and students of this mysterious region are even now but dimly feeling their way through a maze of bewildering complexity. It is not strange, therefore, that theorizers on the methods appropriate to youthful education should have neglected the observation of the mental phenomena, either in the consummate form of a civilised consciousness, or in the historic evolution which has made that form possible. It is only, indeed, within the last fifty years that the thoughts of scientific thinkers have been turned in this direction; and the idea is still so novel that practical teachers in this country can find few aids in literature to deepen their sense of its importance, or to familiarize them with the principle in its actual development.

A very few words will suffice to show the value of the principle itself. The mind of a human being, no less than the body, is a piece of Nature. It has its antecedents and native tendencies, propensities, and untaught yearnings. It might be pardonable in an age ill-accustomed to the strict impartiality of scientific observation, and unprovided with the treasures of comparative research, to imagine that, while the stars seemed to hold their fixed courses, and animals appeared to repeat the same monotonous round of fixed habit from generation to generation, the mind of man rose above the order of the world, was plastic to a practically indefinite extent, and that it lay in the power of an eager trainer, or a strenuous self-will to capacitate it for making unlimited intellectual conquests, or for taking rank with the few moral heroes whose deeds illuminate the pages of history. Proofs pour in thick and fast nowadays, however, to dissipate a belief at once so flattering to human self-sufficiency and so fatal to all true spiritual progress. An unreal picture of individual possibilities may, in certain periods of depression, act as a spiritual tonic, affording the strength to cast off a dangerous self-distrust; but a clear cognition of the permanent causes of our strength and weakness is both a more reliable guide and a more excellent safeguard.

The arts of education must rest, then, upon the conviction that the ground-plan of the future mind is pre-determined in the original constitution. There is a psychical *set*, as there is a physical build, which may

be favoured or thwarted, but which cannot be largely deviated from, although it may require a tutor of extraordinary prescience to foresee the career of the future man. We may, if we please, resolve this constitution into two parts—one supporting the mental fabric, expressing the result of long-continued habit, what the old metaphysician would have termed the 'essence' of man, and the modern biologist describes as the mind of the race; the other summarizing the influence of proximate progenitors. This is, of course, a factitious simplification, though if the case were really no more complex than that, the practical psychologist would have enough work on his hands to harmonize the broad and narrow streams of tendency; but when we remember that the antecedents of each individual mind are absolutely continuous and regressively indefinite in extent, we shall not wonder that the science of mind is still in so elementary a condition, or that human art, which cannot afford to wait upon the slow result of scientific analysis, should proceed swiftly to rules of conduct which later theory will utterly condemn.

The practical difficulty is, to carefully distinguish between those portions of the psychical fabric which are to all intents and purposes unalterable, and those later accretions which are relatively modifiable, and in the latter to faithfully graduate the relativity. It would be alike unreasonable to attempt to change a primal instinct, or to treat a certain vice as beyond the reach of moral therapeutics, because it exhibits an ancestral taint. Some sagacity, again, will be needed to distinguish—in the awkward efforts of unexercised intellect—between the irremediable inaptitude of an unpossessed faculty, and the cerebral immaturity which merely retards what will hereafter be a splendid development. These are some samples of the puzzles which await the instructor. It would be folly to ignore or underrate them. They must be admitted in all their force. But the moral to be drawn from their existence is not that of despair or evasion, but a profounder conviction that real aid must come from a deeper study of the human mind, above all in its comparative aspect. The derivative cannot advance faster than the parent science, and the laws of mind are only slowly emerging out of physical and metaphysical chaos. As my concern in these papers will be directly with the practical teacher, I shall not allow myself to wander from the beaten path of ascertained truths, but limit myself to an indication of those mental conditions which help to form the phenomena of our familiar consciousness, accompanied by such applications as are implied in a conscious direction of the mental processes, with a view to realizing the ideal end of full development of faculty.

Before we proceed to particulars, however, we must first form a correct idea of the kind of object it is whose constitution and mode of operation we are proposing to treat. This object is the human mind. The unfolding and discipline of the human mind is the purport of education. But what *is* the human mind? Does the popular phraseology correctly or adequately describe it? We hear talk of the 'faculties of the mind,' as if it were a *thing* parcelled out into provinces, an engine with unlike parts, which may be variously active or quiescent. Again, there is no more popular presumption than that mind is not body, that it is a self-enclosed sphere, open only to the gaze of an individual self, whose kinship with other individual entities is problematical, or matter of inference. The body is sometimes said to be the mind's 'slave,' at other times its 'master.'

Now, all these varieties of expression are inexact, even when not positively misleading. They are the outcome of rough-and-ready wit, and if taken up without explanation into the scientific vocabulary will seriously vitiate our conception of the actual phenomena.

The dualism thus supposed of body and mind, if taken in the popular sense, is entirely untenable. The perception that mind is *embodied mind* is the mastery of the psychological alphabet. Scientific psychology may be almost said to date from the recognition of that truth. The assertion involves something very different from the current phrase that body, in whole or part, is Organ of mind. Organ supposes substantial separation. The organ is quite distinct from the authority that wields it. It is a passive instrument of a purpose not its own. But in saying that 'mind is embodied mind' we affirm far more than that; we declare that it and its embodiment are one, that the relation is not that of hand and glove, but of hand and flesh and blood; that he who strikes at the body strikes at the mind, that he who wounds the mind wounds the body. This is no mere hypothesis or possible interpretation of facts. It is demonstrated in every ripple of feeling, in every case of mental pathology.

What becomes, then, of the so-called faculties of the mind if this be so? Where are these faculties, and how shall we effect their distinction? If the mind pulsates in the whole body, although with different energy and evidence according to local conditions, and the dominating centres are impotent without their internuncial connections, qualitative difference being grounded on difference of relation, not of elements, how can we, except by a figure of speech, talk of a faculty of judgment, of reasoning, of remembering? As we shall see presently, this phraseology is the record of a primitive attempt at classification, misdirected by a not unnatural illusion of metaphysics.

But there is something more, of scarcely less importance, to be said in regard to the special nature of mind. Theories of mind surviving in popular speech commit a similar error with regard to distinction of mind from mind, to that which they commit in regard to distinction of mind from body. It is supposed that the mind is or may be isolated from its environment, as it may be detached from its objective aspect. Now, although it must be granted that the reflex action known as self-consciousness is a peculiar phenomenon, usually described in the somewhat inappropriate language of a consciousness immediately visible to introspection, this by no means carries with it the implication that a man's mental self is in fact detachable from other mental selves, or that, in truth, there would be any self at all if it were not for a *social self*, the resources of the individual self ever growing with the growth of the social self. Self-education is a dream; there is no such possibility. A mind cannot feed upon itself—must, at the least,

> 'Find tongues in trees, books in the running brooks,
> Sermons in stones,'

and recognize its grandest teachers in the throbbing heart and progressive reason of mankind. To neglect or make light of these ultra-personal

influences is to obscure our view of the most important reality as yet known to us—the human mind. The mind of each one of us at the present day is so remote from the early mind that we cannot possibly put ourselves back in imagination and realise its ruder type. When we reflect what vast controversies, fraught with most important consequences, have hinged on the adoption of a mere *word*, we may vainly picture the cavern-like stagnation of a consciousness capable of being influenced by its fellow only through the crude media of gestures and interjections.

Language is undoubtedly the great fabricator of the social consciousness. But my point is that the individual cannot be detached from the social consciousness, that what I am thinking now is not *my* thought, but the thought of a spiritual organism of which my thought is but a transient expression. If it were not so, how could we so readily communicate our ideas to one another? If we did not share in a common psychical nature, how should we be so readily intelligible to one another? It is not the possession of a common language which alone makes this possible. Language is the body of thought and feeling, a body as intimately one with its spirit as the physical body of the psychical mind, but the informing soul must be present or the body is a dead burden.

How vast the range of personal influence becomes in the social state when this is fully realized, it is needless to enlarge upon. It is this great fact which gives such overwhelming importance to the work of the educator, and enables the schoolmaster who is alive to his responsibilities to shape in great measure the destiny of mankind.

I think these preliminary observations regarding the general nature of mind will suffice for placing the student at what appears to me to be the proper point of view for comprehending psychological problems. They are intended to suggest to the reader certain general conceptions which have not yet received the attention they deserve. At the same time, I fear the value of the truths indicated will for some time to come be rather *regulative* than *constitutive*. By this I mean that they must be treated by the teacher mainly as pre-suppositions, possessing a restraining value, preserving from dangerous error, rather than as presenting positive material which can largely influence practice. For the body of psychological doctrine on which to found practical rules we must still go to the abstract analyst, to the descriptive psychologist, who, treating the mind as a separate finished organism, places in our hands the skeins of association, as they present themselves to his individual inspection. But, although this mode of treatment must still be classed as primary, the historical spirit is beginning to make itself felt in psychology, as in all other departments of life, and the hitherto neglected antecedents of the infant mind are coming to receive their due. Even now Psychogeny is found a potent instrument where simple observation and analysis fail, and we are obtaining glimpses of light where before was darkness and mystery.

Employing such clues as the progress of science offers I shall, in the rest of the present paper, attempt a rapid survey of the field of mental phenomena, presenting these phenomena so far as possible as a connected whole.

In one sense everything which forms a portion of our thought is a mental phenomenon. Although we are tolerably sure that the world is larger than Human Mind, the very conditions of our life prevent us from conceiving that world save in terms of more or less distinct ideation and conscious action. That there are subconscious and unconscious states few will deny, but the *notion* of such states is a fact of consciousness, and it is a fallacy of language when we imagine ourselves capable of transcending this limitation of human spiritual existence. But because we are fast bound within the iron bands of consciousness, it does not follow that the limits of representation should be the limits of belief, and accordingly, while the stream of our mental being yields us only the gold of consciousness, that very gold may bear upon it the mark of its transmutation from the common sand of the unconscious. It is, in truth, so. As Shakespeare said:—

> 'Our little life is rounded with a sleep;'

and consciousness is but a gleam of light in a vast ocean of gloom.

The area of unconsciousness is immeasurably vaster than the area of consciousness, not only without the life of humanity, but also within it. We shall never understand the workings of consciousness itself until we come fully to admit that a vast number of operations are ceaselessly going their silent rounds, of which either no trace exists in consciousness, or of which the effect is perceived without the cause.

The proof of this is found in flashes of so-called inspiration or memory, in incredibly swift perceptions or intuitions, in sudden decisions which pre-suppose long chains of inference and inward struggle. Some psychologists endeavour to resist this evidence. They will have it that as the effect, so must be the cause, that to make the conscious emerge from the unconscious were to violate the maxim *Ex nihilo nihil fit*; and that to find an unconscious antecedent for a conscious consequent is to confuse two eternally opposed spheres of being. But there is nothing self-contradictory in the assertion that existence is larger than mind, and yet the unconscious consubstantial with consciousness. On the contrary the contradiction lies with those who declare we are strictly bound within the fetters of consciousness, and at the same time postulate an unknown substratum as the condition of that consciousness. To argue this point further would lead me too far. We must rest in this place with the verdict of common sense; and the interpretation of experience, which most readily yields practical fruit, is that which conceives the mind as ruminating in stillness over its assimilated material, and from time to time revealing the strange treasures of its wonderful laboratory.

(*To be continued.*)

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A CHEAP VOLTAIC CELL.—A cell suitable for ringing electric bells in houses can be procured in the following cheap but efficacious manner. Get a porous clay pot from an electrical instrument maker (price twopence); put it in an old iron 'tin' and fill up the can with a solution of caustic soda. Then roll up a piece of zinc and stick it in a plug of cork or wood soaked in melted paraffin wax; fill the pot with water and insert the zinc. Solder wires to the zinc and the iron tin, and the cell is complete. The efficacy of the cell may be increased by filling the space between the iron tin and porous pot with iron filings.

Chemistry of the Non-Metallics.

BY EDWARD B. AVELING, D.SC. LONDON.

[This series of articles, whilst dealing with the subjects required by the University of London for the Matriculation Examination and with those required at the Elementary Stage of the Inorganic Chemistry (Branch X.) Science and Art Department, is intended as a practical guide to the philosophical and systematic study of the non-metallics.]

CHAPTER I.—ELEMENTS. MIXTURES. COMPOUNDS. CHEMISTRY. METALS. NON-METALS. SYMBOLS. WEIGHT-NUMBERS. LIST OF ELEMENTS.

LET us suppose that the following substances, all easily procurable, are placed upon the table before the student:—Brimstone, chalk, charcoal, a piece of glass, a bottle of glycerine, gold-leaf, gunpowder, iron filings, iron and powdered sulphur rubbed together in a mortar, a penny, some phosphorus, a shilling, a sovereign, some spermaceti, some starch, a lump of sugar, some sugar dissolved in water, sugar mixed with potassium chlorate (chlorate of potash of the chemist's shop), a glass of water, a piece of zinc.

If the student were asked to attempt some grouping of these twenty things, we may believe that, either unaided, save by his own native wit, or with a little guidance from his teacher, he would after a time place apart from all the rest, the glycerine, the spermaceti, the starch, and the sugar. These all come from plants or animals; these are *organic bodies*. The rest, noting that the organic body sugar occurred in two out of the seventeen things left, he would name *inorganic bodies*.

Considering these sixteen, he would in time place on one side the brimstone, charcoal, gold-leaf, iron, phosphorus, zinc, and he would, if not guided, place with these the three coins, unless he remembered that the penny, shilling, and sovereign are made up of copper, silver, and gold, in each case accompanied by some other substances. This group of six, noting that one of the six occurred in conjunction with iron in another substance on the table, he will separate from the rest, because they are all bodies that have not, as yet, been decomposed or analysed into simpler substances. Brimstone or sulphur, charcoal or carbon, gold, iron, phosphorus, zinc, are *elements* or *simple bodies*.

Turning to the ten things still before him, the student would arrange them in two groups. In one he would place the gunpowder, the iron and sulphur, the solution of sugar, the sugar and potassium chlorate; in the other he would place the chalk, the piece of glass, the water. The one group he would name *mixtures*, the other *chemical compounds*. The gunpowder he would recognise as a mixture of nitre, sulphur, charcoal; the chalk as a chemical compound of calcium, carbon, and oxygen. The penny, shilling and sovereign would present some difficulty. They are alloys of two or three elements. Upon the whole, it is better to place them with the compounds, though they hover close to the border-lines of the two groups of elements and compounds.

FIG. 1.

If, now, the mixture of iron filings and sulphur be placed in a porcelain capsule, and the capsule supported on one of the rings of a retort-stand (Fig. 1), whilst upon a lower ring some wire-gauze is placed, at such a level as to be only just below the bottom of the capsule, and if the flame of a Bunsen burner be applied to the bottom of the capsule through the wire-gauze, the iron and sulphur are found to unite, and a black substance is formed unlike either sulphur or iron. This substance is a compound of the two elements.

If a glass rod is dipped in very strong sulphuric acid and then applied to the mixture of sugar and potassium chlorate, flame bursts out, and a yellow gas is given off. From the mixture certain quite different compounds result, compounds that have not the same properties as the sugar, the chlorate, and the acid, out of which they are made. The *mechanical mixture* (*e.g.*, gunpowder), is made up of two or more elements or compounds, still retaining their individual properties. The chemical *compound* (*e.g.*, chalk), is made up of two or more elements, intimately combined, and its properties differ from the properties of its constituents.

We can now arrange our twenty substances in three columns.

(1) *Elements, not yet decomposed.*	(2) *Mixtures, of two or more bodies, whose properties are unchanged.*	(3) *Compounds, of two or more elements, with change of properties.*
a. Sulphur.	*a.* Gunpowder.	*a.* Chalk.
b. Carbon.	*b.* Iron and Sulphur.	*b.* Glass.
c. Gold.	*c.* Sugar and Water.	*c.* *Glycerine.
d. Iron.	*d.* Sugar and Potassium Chlorate.	*d.* The penny.
e. Phosphorus.		*e.* The shilling.
f. Zinc.		*f.* The sovereign.
		g. *Spermaceti.
		h. *Starch.
		i. *Sugar.
		k. Water.

The compounds marked * are organic.

As far as we know, all bodies in the universe can be arranged under one of these three heads. The study of elements, mixtures, and compounds is *Chemistry*.

Consider the six elements in the first list. They can be grouped into two sets, each of three. The gold, iron, zinc, as *metals*, are separated from the sulphur, carbon, phosphorus, as *non-metals*. The marks of the metallic elements are:—

(1) Solidity. As a rule they are solid bodies, whilst several of the non-metals are gases. Mercury is a liquid metal, and, later on, we shall see reason to believe that the gas, hydrogen, usually classed with non-metals, is metallic in its nature.
(2) Lustre.
(3) Heaviness. As a rule, metals have a greater relative weight than non-metals.
(4) Good conducting powers as regards heat and electricity.
(5) Ductility, from *duco* = I draw (the capability of being drawn out into a wire).
(6) Malleability, from *malleus* = a hammer (the capability of being hammered out into a plate).

These last two properties, whilst they are only possessed by some metals, are not possessed by any non-metals.

We know, at present, some sixty-three elements. Of these the majority are metals. Only fifteen elements at most are regarded as non-metallic, and three of these hover on the border-line between the two classes of simple bodies. In these articles we shall confine our attention to the study of the non-metallics, and to the study of twelve of these. Their names follow in the order in which they will be studied. Opposite each name is written the sign, *symbol*, or abbreviation that is used by students of chemistry for the purpose of saving time. Most of these elements recur so frequently in the study of this science that it is wise and necessary to have some symbol by which to designate them. Lastly, each element has, in addition to its symbol, a number. This I call its *weight-number*. Without entering too fully at present into the meaning of these numbers, it may here be said that they express the relative weights of the different elements under like conditions. Thus hydrogen (1 in the list) is the lightest body known, and oxygen (16 in the list) is, under like conditions, sixteen times as heavy as hydrogen. The phrase 'under like conditions' is of great importance. Thus the solid, carbon, is far more than twelve times as heavy as the gas, hydrogen. But we have evidence that if hydrogen and carbon could be compared in the gas condition, at the same temperature, under the same pressure, the latter would be found to be twelve times as heavy as the former.

So-called Non-Metallic Elements.

Name.	*Symbol.*	*Weight-number.*
Hydrogen	H.	1
Oxygen	O.	16
Nitrogen	N.	14
Carbon	C.	12
Chlorine	Cl.	35·5
Bromine	Br.	80
Iodine	I.	127
Fluorine	F.	19
Sulphur	S.	32
Phosphorus	P.	31
Silicon	Si.	28
Boron	B.	11

So-called Metallic Elements.

[A complete list is given for the purpose of reference, but the student will not have to deal with more than some fifteen of the common metals.]

Name.	*Symbol.*	*Weight-number.*
Aluminium	Al.	27·3
Antimony (Stibium) ...	Sb.	122·3
*Arsenic	As.	75·2
Barium...	Ba.	137·2
Bismuth	Bi.	210·0
Cadmium	Cd.	112·0
Cœsium	Cs.	133·0
Calcium	Ca.	40·0
Cerium...	Ce.	92·2
Chromium	Cr.	52·1
Cobalt	Co.	58·7
Copper (Cuprum) ...	Cu.	63·1
Didymium	D.	95·0
Erbium...	E.	112·6
Glucinum	Gl.	9·3
Gold (Aurum)... ...	Au.	196·7
Indium...	In.	113·4
Iridium	Ir.	196·9
Iron (Ferrum)... ...	Fe.	56·0
Lanthamum	La.	92·9
Lead (Plumbum) ...	Pb.	206·9
Lithium	Li.	7·0
Magnesium	Mg.	24·0
Manganese	Mn.	55·0
Mercury (Hydrargyrum)	Hg.	200·0
Molybdenum	Mo.	96·0
Nickel	Ni.	58·7
Niobium	Nb.	94·0
Osmium	Os.	199·1
Palladium	Pd.	106·6
Platinum	Pt.	197·2
Potassium (Kalium) ...	K.	39·1
Rhodium	Rh.	104·2
Rubidium	Rb.	85·4
Ruthenium	Ru.	104·4
*Selenium	Se.	79·5
Silver (Argentum) ...	Ag.	107·9
Sodium (Natrium) ...	Na.	23·0
Strontium	Sr.	87·5
Tantalum	Ta.	182·3
*Tellurium	Te.	128·0
Thallium	Tl.	203·5
Thorium	Th.	115·7
Tin (Stannum) ...	Sn.	118·1
Titanium	Ti.	50·0
Tungsten (Wolfram) ...	W.	184·0
Uranium	U.	237·6
Vanadium	V.	51·3
Yttrium	Y.	61·7
Zinc	Zn.	65·2
Zirconium	Zr.	89·6

The three elements whose names are marked * are those that are sometimes classed with the non-metals. This fact, and the phrase, 'So-called non-metallic elements,' remind us that our classification, though useful, is artificial.

CHAPTER II.—PLAN OF WORK.

AS we enter upon that study of elements, mixtures, and compounds which we call Chemistry, it is necessary to make clear the method of study. Each of the elements enumerated on the opposite page, will be considered under the following heads :—

A. SYMBOL.
B. WEIGHT-NUMBER.
C. PREPARATION.

First, to paraphrase an apocryphal utterance, 'catch your element.' The method or methods of preparing the simple body under consideration will be studied along these lines.

(1) *Laboratory method.*—A description of the experiment necessary, with the substances and apparatus used, and the names of the products formed.

(2) *Symbols of the reaction.*—The shorthand notes of the experiment just described are given in the chemical symbols of the bodies used and the substances formed.

(3) *Weights and volumes.*—The relative weights of the materials concerned in the preparation and their volumes (when they are gases) are calculated. The table of weight-numbers on the opposite page is of use here.

D. PROPERTIES.—These are studied in the order in which they would seem to strike the observer; the most general are taken first, the most special later.

(1) *Condition.*—Whether the body is a solid, a liquid, or a gas. If it is a solid or a liquid, the temperature at which it melts or boils should be given. If it is a gas, the ease or difficulty with which it is liquefied should be noted.

(2) *Effect on the senses.*—Those of touch, taste, smell, sight.

(3) *Specific gravity.*—The relative weight, as compared with distilled water at a temperature of 4° and under a pressure equivalent to the weight of a column of mercury 760 millimetres (about thirty inches) in height, if the body is a solid or a liquid; as compared with hydrogen or air, if the body is a gas. The number that represents the specific gravity of a body also represents its *density*. But specific gravity and density are no more the same thing than the number of pence in a shilling and the number of months in a year. Specific gravity is relative weight. Density is relative mass. Weight is the force with which a body tends to move towards the earth. Mass is amount of matter. If everything in the universe could be annihilated except one pound of lead, that lead would no longer have any weight, but its mass would be the same as before.

(4) *Solubility.*—In water or in acids.

(5) *Relation to combustion.*—Whether the element is combustible or not, is a supporter of combustion or not.

(6) *Specialties.*—Under this head are recorded such properties as are not considered under any of the preceding heads; as, *e.g.*, the reaction upon litmus paper or any special tests for the particular element.

E. MIXTURES AND COMPOUNDS INTO WHICH IT ENTERS.

The mixtures and compounds will be studied upon the same plan as the element. That is, the symbol, weight-number, preparation, properties of each mixture, and of each compound will be studied wherever they admit of study.

I sum up this plan, and earnestly advise each student to use it, or some similar—and possibly better—scheme. Every fact in regard to every element, mixture, or compound, should be thought of under its proper head in this plan. Its relationship to other facts will thus be rendered clear, and the remembrance of it will be made more easy.

PLAN.

A. SYMBOL.
B. WEIGHT-NUMBER.
C. PREPARATION.—(1) Laboratory method.
(2) Symbols of reaction.
(3) Weights and volumes.
D. PROPERTIES.— (1) Condition.
(2) Effect on senses.
(3) Specific gravity.
(4) Solubility.
(5) Relation to combustion.
(6) Specialties.
E. MIXTURES AND COMPOUNDS.—Each studied under heads *A*, *B*, *C*, *D*.

(To be continued.)

ANSWERS TO ARITHMETICAL QUESTIONS IN THE 'SCHOLAR' FOR MARCH, 1884.

STANDARD IV.

A. 1. £85 1s. 10$\frac{3}{4}$d.
2. £92 8s. 5$\frac{1}{4}$d.
3. 31,622,400 sec.
B. 1. 13 lb. 4 oz. 1 dwt. 5 gr.
2. £28 7s. 11$\frac{1}{2}$d. – 83.
3. 2,718,220 oz.
C. 1. £7094 7s 3$\frac{1}{2}$d.
2. 3s. 9d.
3. 15 c. yd. 8 ft. 1171 in.
D. 1. 15 ton 9 cwt. 1 qr. 14 lb.
2. 49,957,330,802,500.
3. £46,136 5s.
E. 1. 18s. 10$\frac{1}{2}$d. – 14,070.
2. 158 r. 10 q. 3 sh.
3. 1,176,120 sq. in.
F. 1. 8$\frac{3}{4}$ yds.
2. 214 ton 6 cwt. 2 qr. 20 lb. 15 oz.
3. 18,000 marbles.

Advanced Examination.

1. £1657 6s. 8d.
2. 1223 ton 16 cwt. 1 qr. 4 lb. 8 oz.
3. Girl 4s. 4d., boy 3s. 6d.

STANDARD V.

A. 1. £3412 10s.
2. 10s 6d.
3. £3 15s. 10$\frac{1}{2}$$\frac{1}{2}$d.
B. 1. 3$\frac{3}{8}$.
2. £3085 2s. 9$\frac{3}{4}$d.
3. £4 11s. 8$\frac{1}{2}$$\frac{3}{8}$d.
C. 1. £6 9s. 11$\frac{1}{2}$d.
2. £187 10s.
3. $\frac{1}{2}$$\frac{3}{8}$.
D. 1. £7 12s. 3d. loss.
2. £5529 14s. 11d.
3. 46 gallons.
E. 1. £1,493,350 8s. 2d.
2. £44 5s. 8d.
3. £123 7s. 1$\frac{1}{2}$d.
F. 1. 316,120 minutes.
2. 7 mls. 913 yds. 2 ft. 5 in. – 511.
3. 176 ft.

Advanced Examination.

1. £56 18s. 10d.
2. £145 17s. 1$\frac{3}{4}$$\frac{3}{4}$$\frac{1}{4}$d.
3. £5 9s. 4d.

STANDARD VI.

A. 1. £18 0s. 5$\frac{3}{4}$d.
2. $\frac{1}{2}$$\frac{8}{5}$.
3. ·004.
B. 1. £91 14s. 10$\frac{8}{10}$$\frac{8}{0}$d.
2. £19 17s. 1$\frac{1}{2}$d.
3. £91 16s.
C. 1. 126 rats.
2. 3$\frac{7}{8}$.
3. ·00078125.
D. 1. ·0010845.
2. £6 15s. 5$\frac{1}{2}$$\frac{1}{4}$d.
3. $\frac{1}{5}$ of the estate.
E. 1. ·02857+
2. 44$\frac{1}{2}$ hours.
3. 750 yards.
F. 1. £5 0s. 1$\frac{3}{8}$$\frac{7}{8}$$\frac{1}{2}$d.
2. 4$\frac{1}{6}$ per cent.
3. 110$\frac{3}{8}$ days.

Advanced Examination.

1. £2250, £2000, £1500, and £1200.
2. £91 5s.
3. £219 13s. 7$\frac{1}{2}$d.

STANDARD VII.

A. 1. 14s. 10$\frac{1}{2}$d.
2. £9 6s. 8d.
3. 2$\frac{5}{11}$ years.
B. 1. £346 17s. 6d.
2. £55 16s. 9$\frac{1}{2}$d.
3. £83 12s. 1$\frac{5}{6}$$\frac{1}{4}$d.
C. 1. £147$\frac{1}{2}$$\frac{1}{2}$.
2. £835 13s. 4d.
3. 46$\frac{1}{2}$ per cent.
D. 1. 1$\frac{3}{8}$ per cent.
2. £4 7s. 10$\frac{1}{2}$$\frac{1}{4}$$\frac{1}{8}$d.
3. 37$\frac{1}{2}$$\frac{1}{4}$.
E. 1. 1$\frac{3}{16}$ mistakes.
2. 1$\frac{2}{7}$$\frac{1}{4}$ per cent.
3. 5625.
F. 1. ·485 per cent.
2. 2$\frac{9}{2}$ p. c. gain.
3. £59,333 8s.

Advanced Examination.

1. £307 12s. 0·18072l2d.
2. £41 a year gain.
3. 16$\frac{1}{4}$ inches.

SOLUTIONS OF THE 'ADVANCED EXAMINATION' QUESTIONS IN 'THE SCHOLAR' FOR MARCH, 1884.

STANDARD IV.

1. 4s. 8d. × 4$\frac{1}{2}$ = 19s. 10d. cost of cloth, + 17s. 10d. = £1 17s. 8d. total cost of each suit; and £1 17s. 8d. × 880 = £1657 6s. 8d. Ans.

2. 1223 ton 16 cwt. 1 qr. 4 lb. 8 oz. Ans. (Only a test of mechanical accuracy.)

3. 10d. × 90 = £3 15s. excess that the 90 girls receive in addition to an equal division with the boys. £34 4s. − £3 15s. = £30 9s., which, divided by (90 g. + 84 b.=) 174 = 3s. 6d. a boy's share, + 10d. = 4s. 4d. a girl's share. Ans.

STANDARD V.

1. The four items are 10s. 6d. + £16 10s. + £22 10s. + £17 8s. 4d. = £56 18s. 10d. Ans.

2. 38 ton 17 cwt. = 777 cwt., which, at 3s. 9d. a cwt. = £145 13s. 9d.

	£	s.	d.						
2 qr. is ½		3	9						
			777						
	145	13	9	price of 38 ton 17 cwt.					
1 ,, ,, ½	0	1	10½	,, ,,			2 qr.		
14 lb. ,, ¼	0	0	11¼	,, ,,			1 ,,		
2 ,, ,, ¼	0	0	5⅛	,, ,,				14 lbs.	
1 ,, ,, ¼	0	0	0 1/16	,, ,,				2 ,,	
8 oz. ,, ¼	0	0	0 1/32	,, ,,				1 ,,	
4 ,, ,, ¼	0	0	0 1/64	,, ,,					8 oz.
	0	0	0 1/128	,, ,,					4 ,,
					ton	cwt.	qr.	lb.	oz.
	£145	17	1 1/128	,, ,,	38	17	3	17	12

3. £12 3s. 4d. ÷ 365 = 8d. a day. From May 17th to Oct. 28th, the latter exclusive, is 164 days, which at 8d. a day = £5 9s. 4d. Ans.

STANDARD VI.

1. ½ + ⅓ + ¼ + ⅕ = 45+40+30+24/120 = 1 19/120 which exceeds a unit or integer—*one*. Hence, as these *fractions* cannot really be received by each, their several *ratios* must be received instead. Consequently, the whole must be divided into 139 parts instead of 120, the first receiving 45/139, second 40/139, etc. Now 1 19/139 of £6950 = £50, then £50 × 45 = £2250; £50 × 40 = £2000; £50 × 30 = £1500; and £50 × 24 = £1200. Answers.

2. Bringing the women and boys in the consequent to their equivalents in men, we have 15 boys = 6 men, since 20 boys = 8 men; and as 8 men = 12 women, a woman = ⅔ of a man, and ⅔ of 20 = 13⅓ men. Then 5 men (given) + 13⅓ men + 6 men = 24⅓ men. Then by proportion and cancelling—

$$£\frac{20 \times 24\frac{1}{3} \text{ men} \times 24}{8 \times 16} = £91\ 5s.$$ Ans.

3. 5·15 pecks × 32·5 × 20 = 3347·5 pecks = 104·609375 quarters, the produce of the 20 acres. And £2·1 × 104·609375 = £219 13s. 7½d. Ans.

STANDARD VII.

1. Four per cent. for a year = 1 1/25, therefore for a quarter it = 1 1/100. There being 6 quarters in the 1½ years, 1 1/100 must be added successively 6 times.

1 1/100	5000	
	50	
1 1/100	5050	amount at the end of the 1st quarter
	50·5	
1 1/100	5100·5	,, ,, ,, ,, 2nd ,,
	51·005	
1 1/100	5151·505	,, ,, ,, ,, 3rd ,,
	51·51505	
1 1/100	5203·02005	,, ,, ,, ,, 4th ,,
	52·0302005	
1 1/100	5255·0502505	,, ,, ,, ,, 5th ,,
	52·550502505	
	5307·600753005	,, ,, ,, ,, 6th ,,
	5000·	
	307·600753005 = £307 12s. 0·18072120d. Ans.	

2. £41,000 at 4 per cent. = £1640 yearly income. £102·5 (¼ being deducted for brokerage) × 410 = £42,025 amount received on selling out the 4 per cent. stock. £124¼ + ¼ = £125 cost of £100 stock in the 5 per cents.; and £42,025 ÷ 125 = 336 cents. of 5 per cent. stock bought. Then £5 × 336 = £1681 yearly income from the 5 per cents.; and £1681 − £1640 = £41 gain. Ans.

3. 10½ inches × 16 = 168 inches the aggregate of the 16 tides.
11¼ ,, × 20 = 225 ,, ,, 20 ,,
Then 225 − 168 = 57 ,, ,, last 4 ,,

From the data the 18th tide was 1½ inches above the 17th; the 19th *three* inches above the 17th; and the 20th *four and a-half* above the 17th tide. Taking these excesses (1½ + 3 + 4½ = 9) from the 57 we have 48, which ÷ 4 = 12 inches the 17th tide, and 12 in. + 4½ in. = 16½ inches. Ans.

Science Notes.

SIR CHARLES WILLIAM SIEMENS.—On the 19th of November an eminent scientist, well known in England as in other countries, passed away. Charles William Siemens, born April 4, 1823, at Leuthe in Hanover, was educated at Lubeck, Magdeburg, and Göttingen University. He was only twenty years old when he came to England with his brother Werner to realise an invention for electro-gilding, and so successful were they that William made England his home. His chief services to science may be noted in chronological order as follows: a double-cylinder air-pump, and a simple water-meter; a four horse-power steam engine with regenerative condensers, which gained him the gold medal of the Society of Arts in 1850; a modification of Grove's secondary battery; two steam engines with regenerative condensers for the Paris Exhibition of 1855; submarine cables; a pyrometer based on the principle of using the increased resistance of metallic conductors due to the rise of temperature as a means of measuring temperature; the regenerative gas furnace, his most famous invention, with which his brother Frederick was also associated; and as a consequence of the latter invention the production of steel on the open hearth, an industry now employing thousands of men; a barometer for measuring depth of the sea, and so on. Besides these his contributions to scientific literature are equally numerous and valuable; he was a member of nearly all the scientific societies of Great Britain: a D.C.L. of Oxford University in 1870, an LL.D. of Glasgow in 1880, of Dublin in 1882, in which year he also received the degree of Ph.D from Würtzburg. He was knighted by Her Majesty in March last, and had received recognition of his services from the Emperor of Brazil, the Shah of Persia, and from France under the Empire and under the Republic.

* * * * *

ASBESTOS.—There seems no limit of the uses to which asbestos can be applied; asbestos filters have recently been introduced into chemical laboratories, where their power of resistance to the action of strong acids, as well as of heat, render them especially valuable. Gloves of asbestos are also useful as protecting the skin from acids, and asbestos paper for protecting tables, etc., from acid stains. It makes good porous cells for batteries, but perhaps its most ingenious use is as an air filter. M. de Luynes has drawn the attention of the Société d'Encouragement of Paris to M. Eppé's invention in this connection, by which the air is blown by means of a fan through a bed or layer of asbestos six inches thick; the air is thus deprived of dust particles, and also is purified from germs of disease or fermentation.

THE LATE MR. HUGH POWELL.—We regret to see the notice of the death of Mr. Hugh Powell, the eminent optician. It was almost fifty years ago when, in 1834, he gained a silver medal at the Society of Arts 'for a stage for a microscope.' In 1840 he made the first achromatic object glass of one-sixteenth of an inch focal length ever seen in this country. In 1841 the Society of Arts again awarded him a silver medal 'for his mode of mounting the body of a microscope.' He was also the first English optician to construct object glasses on Amici's 'immersion' system. Still later he succeeded in constructing an object glass of a focal length of one-eightieth of an inch. He was one of the earliest fellows of the Royal Microscopical Society, founded at London in 1840. His son is, we believe, continuing his father's experiments on the more recently developed 'homogeneous immersion' system.

Music.

BY RALPH DUNSTAN, MUS. BAC., CANTAB.;
L. MUS., T.C.L.;
Member of the Council of the Tonic Sol-fa College, etc.

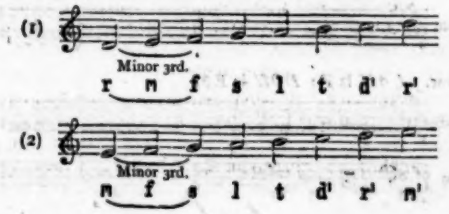
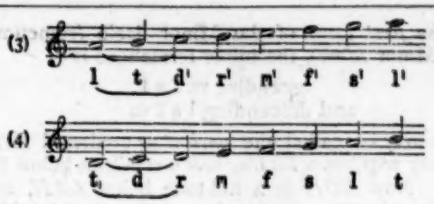
(Continued from Vol. III., page 591.)

TERMS OF STYLE:—

Ad libitum, *Ad lib.*, at the discretion of the performer (as *Rall. ad lib.*).
Agitato, with agitation.
Animato, with animation.
A poco a poco, little by little, by degrees (used to qualify some term of Expression or Speed).
Assai, very, enough (as *Allegro assai*).
Ben, well.
Brillante, in a brilliant, showy style.
Con brio, with energy.
Con espressione, with feeling or expression.
Con fuoco, with fire.
Con moto, with spirit (or motion).
Con tenerezza, with tenderness.
Grazioso, gracefully.
Legato, smoothly, in a gliding manner.
Ma, but.
Maestoso, in a grand, broad, majestic style.
Marcato, marked and emphatic (*Ben marcato*, well emphasized).
Mezzo, half (*Mezzo forte*, half or moderately loud).
Molto, much, very (*Andante molto*).
Non, not. *Più*, more. *Poco*, little. *Quasi*, almost, in the style of.
Segue, it follows. *Sempre*, always (as *Sempre ff.*)
Sostenuto, with the notes sustained their full length.
Staccato, with the notes cut short.
Tenuto, *ten.*, sustained.
Vivace, in a quick, sprightly manner.
Volti, Turn over (as *Volti subito*, Turn over quickly).

THE MINOR SCALE IN ITS VARIOUS FORMS.

Major Scales are so called because the interval from the Tonic or Key-note to the third note of the scale is a *Major* Third; when, however, the third of a scale is *Minor*, it is called a *Minor Scale*.

The student will readily perceive that there are a great many minor scales of various kinds:—

These minor scales are all formed from the notes of the scale of C major, and we may form the same number from the notes of any other major scale. All these minor scales were used before the introduction of Harmony; but in Modern Music, No. 3 only is employed, and is so much modified in its use that it appears under several distinct forms.

THE MODERN MINOR, as it is generally called, is represented in Tonic Sol-fa Notation by the notes

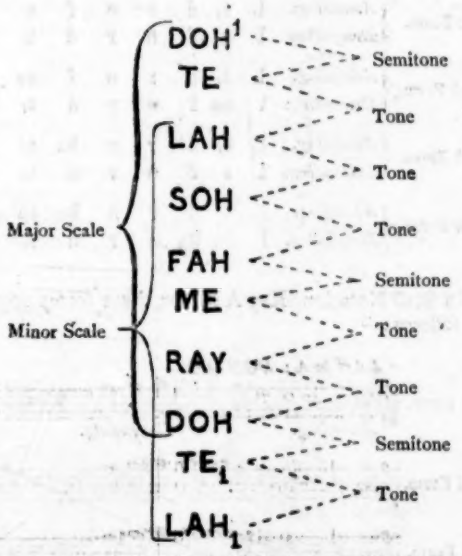
l, t, d r m f s l,

and various modifications of some of these notes.

LAH is regarded as the *Tonic* or *Key-note*, while *DOH*, the Tonic of the Major Scale, is the Minor Third of the Minor Scale.

The Scale of *DOH* and the scale of *LAH* (a minor third below or a major sixth above) are said to be *Relative* to each other. Thus, in the Major Scale of C, *LAH* is A, and the Scale or Key of A minor is said to be the *Relative Minor* of the Scale or Key of C Major: and similarly, the Scale or Key of C Major is said to be the *Relative Major* of the Scale or Key of A Minor.

The relation of the two scales may be shown thus:—



Taking **l, t, d r m f s l** as forming our typical minor scale, let us see how this scale is modified, and under what conditions these modifications take place.

The Minor Scale (like the Major) comprises two Tetrachords; the *lower* tetrachord **l, t, d r** and the *upper* tetrachord **m f s l**. Except in one peculiar case, the lower tetrachord is *fixed*, always consisting of the same four notes; but the upper tetrachord is *variable*.

In the *first* form of the Minor Scale (sometimes called Minor *Mode*), the upper tetrachord is—

ascending **m f s l**
and descending **l s f m**

This may be called the *ancient* or unaltered form. Harmony requires a *leading-note* a semitone below the Tonic. Now *SOH* is a full-tone below *LAH*, and must therefore be *sharpened a semitone* to *SE*, which is the leading-note in the Minor Scale.

The second form is therefore—

ascending **m f se l**
descending **l se f m**

This is the *true* form, or the *Harmonic form*; in other words, it is the form required by Harmony.

Observe, however, the peculiar interval between *FAH* and *SE*. This interval, called an augmented second, is so difficult to sing that *FAH* is often sharpened a semitone also. The new note is not called *FE*, as you might perhaps expect, but *BAH*. (Observe that *FE* is the *ordinary* sharp of *FAH*, and that *BAH* is the sharp of *FAH* used only in the Minor Scale.)

The third form of the Minor *ascending* is

m bah se l

which is identical as to interval with the upper tetrachord of the Major Scale, **s l t d¹**.

The tetrachord of this third form is generally **l s f m** (like the unaltered form): though, occasionally, **l se bah m** may be used, thus giving rise to a *fourth* form.

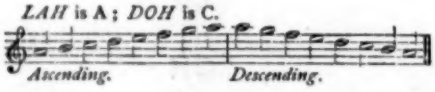
MINOR SCALE OR MODE.

1st Form.	*Ascending.*	l,	t,	d	r	m	f	s	l
	Descending.	l	s	f	m	r	d	t,	l,
2nd Form.	*Ascending.*	l,	t,	d	r	m	f	se	l
	Descending.	l	se	f	m	r	d	t,	l,
3rd Form.	*Ascending.*	l,	t,	d	r	m	ba	se	l
	Descending.	l	s	f	m	r	d	t,	l,
4th Form.	*Ascending.*	l,	t,	d	r	m	ba	se	l
	Descending.	l	se	ba	m	r	d	t,	l,

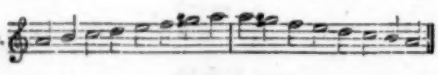
In Staff Notation, Key A Minor, these forms appear as follows:—

LAH is A; *DOH* is C.

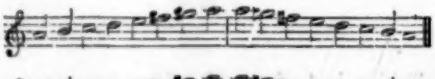
1st Form. *Ascending.* *Descending.*



2nd Form.



3rd Form.



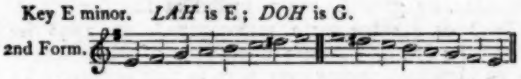
4th Form.

N.B.—The 1st, 2nd, and 4th forms are the same ascending and descending.

The following is a table of the Minor Scales most usually employed. The Second and Third Forms only are given, but the student will have no difficulty in writing the others for himself.

Key E minor. *LAH* is E; *DOH* is G.

2nd Form.



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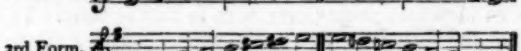
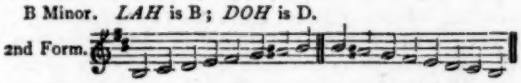


B Minor. *LAH* is B; *DOH* is D.

2nd Form.



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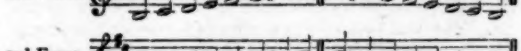
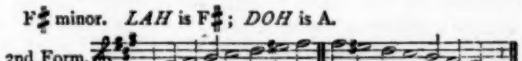


F♯ minor. *LAH* is F♯; *DOH* is A.

2nd Form.



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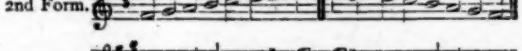
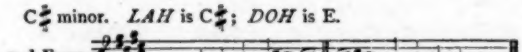


C♯ minor. *LAH* is C♯; *DOH* is E.

2nd Form.



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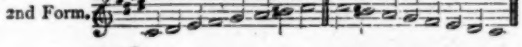
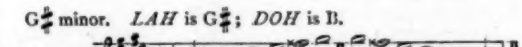


G♯ minor. *LAH* is G♯; *DOH* is B.

2nd Form.



F, which was already sharpened, now requires a double-sharp ×.

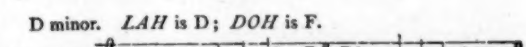
3rd Form.

The double-sharp is contradicted by the single-sharp sign.

It is unnecessary to give the Scales of D sharp minor and A sharp minor; but the student is advised to practise writing them.

D minor. *LAH* is D; *DOH* is F.

2nd Form.



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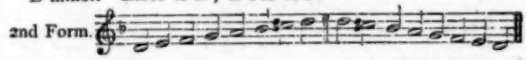
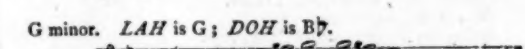


G minor. *LAH* is G; *DOH* is B♭.

2nd Form.



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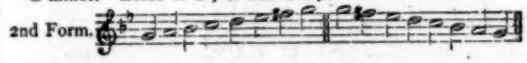
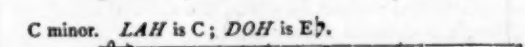


C minor. *LAH* is C; *DOH* is E♭.

2nd Form.



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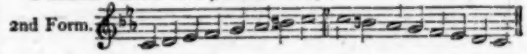
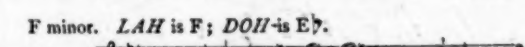
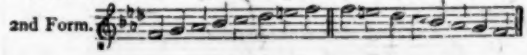


F minor. *LAH* is F; *DOH* is E♭.

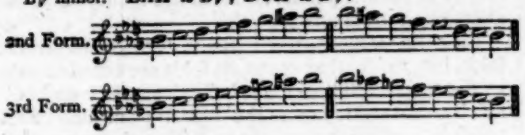
2nd Form.



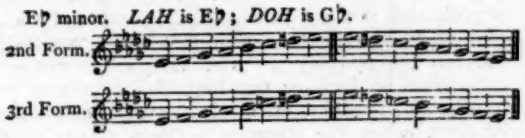
3rd Form.



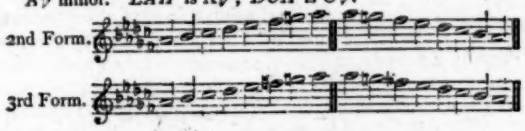
B♭ minor. *LAH* is B♭; *DOH* is D♭.



E♭ minor. *LAH* is E♭; *DOH* is G♭.



A♭ minor. *LAH* is A♭; *DOH* is C♭.



The student will remember that, in Major Scales, the semitones invariably occur between the *third and fourth* and between the *seventh and eighth* notes. In Minor Scales the semitones vary in position and number, according to the *form* of the scale.

Thus, in the *first* form l$_1$ t$_1$ d r m f s l they occur between the *second and third* and between the *fifth and sixth;* in the *second* form

l$_1$ t$_1$ d r m f se l,

they occur between the *second and third*, between the *fifth and sixth*, and between the *seventh and eighth*. In this form of the Minor Scale there is one interval larger than a tone, viz., the interval from *FAH* to *SE*. On account of this *Chromatic* interval (an augmented second), the second form of the Minor Scale is called by some theorists the *Chromatic Form*.

In the *third* form, ascending, l$_1$ t$_1$ d r m bah se l, the semitones fall between the *second and third* and between the *seventh and eighth;* descending,

l s f m r d t$_1$ l$_1$,

between the *sixth and fifth* and between the *third and second*.

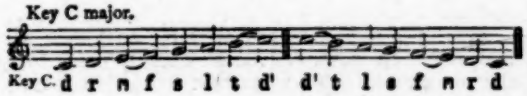
The student will perceive that Relative Major and Minor Keys have the *same signature*.

Thus, A Major and F♯ Minor are Relative Keys, both having the signature etc.

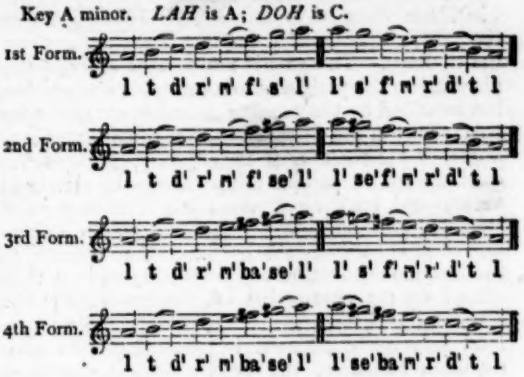
The terms TONIC MAJOR and TONIC MINOR are used to signify keys with the same Key-note or Tonic; as C Major and C Minor, F Major and F Minor, etc. Thus, while the Relative Minor has the *same signature* as its Relative Major, the *Tonic* Minor has *three flats more* or *three sharps less* in the signature than its Tonic Major.

Study carefully the following, and go through all the other scales in the same way.

Key C major.

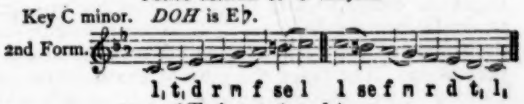


RELATIVE MINOR.

Key A minor. *LAH* is A; *DOH* is C.

1st Form.
l t d' r' m' f' s' l' l' s' f' m' r' d' t l
2nd Form.
l t d' r' m' f' se' l' l' se' f' m' r' d' t l
3rd Form.
l t d' r' m' ba' se' l' l' s' f' m' r' d' t l
4th Form.
l t d' r' m' ba' se' l' l' se' ba' m' r' d' t l

TONIC MINOR OF C MAJOR.

Key C minor. *DOH* is E♭.



(To be continued.)

Physiology.

BY ARTHUR NEWSHOLME, M.D. LOND.,

Gold Medallist and University Scholar, Physician to the City Dispensary.

CHAPTER VIII.—DIGESTION—*(continued)*.

Prolonged boiling of casein or flesh, alone or with a dilute acid, produces a substance similar to and apparently identical with peptone. It would seem, therefore, that pepsin simply facilitates a change of hydration, which may be performed in its absence.

Peptones are not found in the circulation: they are absorbed by the capillary veins leading from the stomach to join the portal vein, which enters the substance of the liver. They are not present in the blood of the portal vein, (M. Foster.) It would seem, therefore, that peptones become changed again into albuminoids, immediately after their entry into the blood.

Various circumstances affect the rapidity and ease of gastric digestion. The greater the surface exposed to the action of gastric juice, and the more quickly solution of the food occurs. Thus fine division of food by mastication or other means, and constant movement of it, aid digestion. The presence of a large excess of the products of digestion impedes digestion. Neutralisation of gastric juice arrests it entirely; and it is most active with a juice, the acidity of which is ·02 per cent. It is most active at a temperature between 35 and 40° Cent.; very hot and very cold liquids are, therefore, harmful. The activity of artificial gastric juice is entirely destroyed by boiling for a few minutes.

The mental condition has an important influence on digestion. Worry or bad temper commonly produce indigestion. Exercise immediately after meals is injudicious; and so likewise is an immediate return to brain work, as these direct the flow of blood away from the digestive organs. The stomach ought to be fairly filled, but not distended. The French plan of having only breakfast and dinner, and these necessarily large meals, is not advisable; the best division is into three meals a day, at fairly equal intervals; allowing ab ut five hours intervals between them, in order that the stomach may become quite empty.

There are two factors concerned in gastric digestion: First, the *chemical* action already considered; and, secondly, a *mechanical* action due to the movements of the stomach. The gastric movements are essentially identical to the peristaltic movements of the intestines, but modified by the peculiar arrangement of the muscular fibres in the stomach. A sort of churning is produced of the contents of the stomach, the food being carried from the cardiac orifice, along the greater curvature and back along the lesser curvature of the stomach, while subsidiary currents keep up a circulation of food between the centre of the stomach and the mucous membrane. The pyloric orifice is tightly closed by the contraction of the involuntary fibres forming the pyloric sphincter, and thus the escape of food into the duodenum is prevented. As gastric digestion advances, the pyloric sphincter gradually relaxes, and more and more of the products of gastric digestion escape. The movements of the stomach gradually increase in force as digestion proceeds, and the acidity of the gastric juice increases in an equal proportion. The exact character of the nervous mechanism governing the gastric movements is very doubtful. It is probably some ganglionic apparatus in connection with the sympathetic system. Section of both pneumogastric nerves causes spasmodic closure of the cardiac orifice of the stomach and accumulation of food in the œsophagus.

The chyme resulting from gastric digestion after leaving the stomach enters the small intestine, where it is subjected to other digestive changes. It will be convenient at this point to describe the structure of the small and large intestine, and of the glands appended to them, the liver and pancreas.

The *small intestine* forms a convoluted canal, commencing at the pylorus, and ending in the large intestine, at the ileo-cœcal valve. It is about twenty feet long in the adult, and its convolutions occupy the middle and lower part of the abdomen, surrounded by the large intestine (Fig. 35). It is arbitrarily divided into three parts, the first ten or twelve inches being called the *duodenum*, in the concavity of which lies the pancreas, the upper two-fifths of the remainder being named the *jejunum*, and the lower three-fifths the *ileum*. Like the stomach, the small intestine has four coats, serous or peritoneal, muscular, submucous, and mucous. The *serous* coat embraces the whole of the small intestine, except a part of the duodenum. The *muscular* coat consists of unstriped muscular fibres arranged in two sets, an outer longitudinal and an inner circular. The progressive contraction of this coat from above downwards causes the vermicular or peristaltic movements, by means of which the contents of the bowel are forced onwards. The movements of the intestine occur in a wave-like manner, and involve movements of individual parts, and also a frequent change of position of the whole. The *submucous* coat consists of areolar tissue, and connects the mucous and muscular coats together.

The *mucous membrane* shows on its inner surface a finely flocculent appearance, due to minute prominences studding its surface, called 'villi.' It is extremely vascular, one of the most vascular membranes in the body. Like the stomach, it is coated throughout with a single layer of columnar epithelium; and in its deepest part, next to the submucous coat, is bounded by a layer of unstriped muscular fibres (*muscularis mucosæ*). Between these parts it consists chiefly of tubular glands and retiform tissue, containing abundant vessels and lacteals.

Like the stomach, the mucous membrane presents folds, but, unlike that organ, its folds are not obliterated by distension. These folds, called *valvulæ conniventes*, reach transversely across the bowel from one-half to two-thirds of its circumference. Their largest amount of projection is about $\frac{1}{3}$ inch. Each consists of a fold of the mucous membrane, with some submucous tissue between the two layers. The valvulæ conniventes commence an inch or two beyond the pylorus, becoming much more numerous in the upper half of the jejunum, when the distance between them is not greater than the breadth of one of the valves. Below this point they gradually diminish in size, disappearing entirely about the middle of the ileum. They serve to supply a greatly increased mucous surface for digestive purposes, and for the absorption of digested food; and prevent the food from being hurried along too quickly.

The *villi*, already named, occur only in the small intestine, giving its surface a characteristic velvety appearance. They can be best seen by removing a piece of intestine from a rabbit, washing it carefully, and then examining it with a pocket lens under a shallow layer of water. The water serves to float up the villi. Each villus is $\frac{1}{36}$ to $\frac{1}{48}$ of an inch in width, or more. In the upper part of the small intestine they have been estimated to number from 600 to 1000 in a square inch, and in the lower part from 480 to 800 in the same space. Krause calculates their total number as at least four millions.

Each villus is practically a prolongation upwards of the mucous membrane. Its free surface is covered by columnar epithelium; inside this is a delicate basement membrane, on which the columnar cells rest; the rest of the villus being occupied by retiform tissue, supporting the ultimate branches of a minute artery, a few unstriped muscle fibres, and one or more lacteal vessels. Minute twigs of nerves are probably also present in the villus. The lacteal vessel lies in the middle of the villus, and either ends in a blind dilated extremity, or there may be two lacteals ending in a loop. The epithelioid cells of the lacteal vessel are continuous with the branched cells of the retiform tissue, and these with the flattened cells of the basement membrane; and it is probable that prolongations from the last-named cells extend between the columnar cells towards the mucous surface. It is possible that the emulsified fat is absorbed by means of these processes into the lacteals; but, according to some authorities, the columnar cells absorb the fat in an amœboid fashion, and then give it up to the lacteal on their opposite side. The muscular tissue in the villus probably serves to retract the villus and drive the contents of the lacteal vessel into a larger lacteal vessel (Fig. 38) in the submucous tissue, where it joins other lacteal vessels, and finally forms the thoracic duct.

Tubular glands (crypts of Lieberkühn) are found throughout the small and large intestine. They are similar to those in the stomach, only they are never divided. They are simple prolongations downwards of the mucous membrane, lined like the general surface with columnar epithelium; they vary in length from $\frac{1}{30}$ to $\frac{1}{10}$ of a line, and have a diameter of about $\frac{1}{50}$ line.

Brunner's glands, named after the anatomist who first described them, are almost entirely confined to the duodenum. They present transitional forms

between compound racemose and compound tubular glands, and have essentially the same structure as

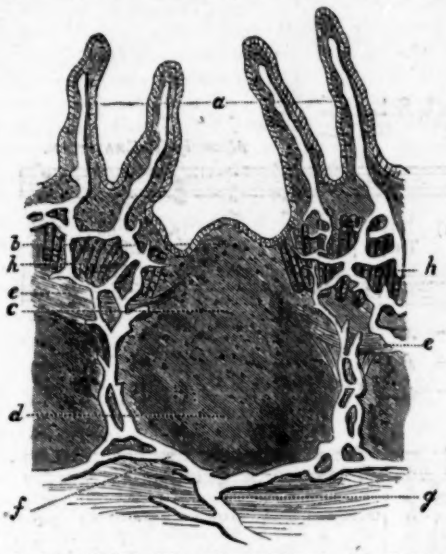


Fig. 38.—Closed Follicle, Villi, and Lacteal Vessels of Small Intestine. Vertical section, magnified 30 times
(*a*) Villi enclosing Lacteal Vessels. (*b c d*) Closed Follicle. (*e*) Muscularis mucosæ. (*f g*) Larger Lacteal Vessels. (*h*) Crypts of Lieberkuhn.

small salivary glands, or as the pancreas. Their lower ends are embedded in the submucous coat.

Closed follicles occur in two forms in the small intestine. 1st, *solitary glands*, and 2nd, *agminated glands*, or glands of Peyer. The structure in the two cases is identical. Each follicle is about the size of a millet-seed, and is composed of retiform tissue, in the meshes of which are embedded numerous lymphoid cells, the whole tissue being traversed by fine capillaries. The follicle is situated chiefly in the submucous tissue, but causes a slight bulging upwards of the mucous membrane; and at this part it is studded all over with villi, while around it the orifices of tubular glands are seen (Fig. 38).

Agminated glands are composed of groups of these lymphoid follicles, each group being arranged lengthwise along the intestinal wall, thus forming an oblong figure, from half to two, or even four inches long. The agminated differ from the solitary follicles in having no villi on their surface. There are thirty or more of them in the whole course of the small intestine.

The *large intestine* extends from the termination of the ileum to the anus. It is divided into the cœcum, colon, and rectum. Its length is about 5 or 6 feet, or one-fifth of the whole length of the intestine. It has a much larger diameter than the small intestine; and in addition to this feature, it can be distinguished from the small intestine by the occurrence of constrictions at varying intervals, causing the bowel to have a sacculated appearance, and by the presence of three longitudinal bands of muscular tissue.

The *cæcum* is that part of the large intestine situated below the point of junction of the small and large intestine. It is about 2½ inches long, and is situated in the lowest part of the abdomen on the right side. Coming off from its inner and back part is a tapering diverticulum about the size of a large quill, and 3 to 6 inches long, called the *appendix vermiformis* (Fig. 35). Small foreign bodies such as cherry-stones, may become impacted in this cul-de-sac, and even perforate through its coats, with a fatal result. The *ileo-cæcal valve*, preventing return of the intestinal contents from the large into the small intestine, is composed of two segments which project inwards towards the cœcum, formed of prolongations of the mucous and muscular coats of the ileum. The cœcum is the point at which, when constipation occurs, fæces are apt to get impacted. It will be noticed that the course the intestinal contents have to take after leaving the cœcum is upwards along the ascending colon. The long retention of fæces in the cœcum is apt to lead to inflammation of its coats, and occasionally perforation through them. After the cœcum, the *ascending colon* reaches up to the under surface of the liver; it then stretches across the upper part of the abdomen as the *transverse colon*, and descends on the left side as the *descending colon*, forming at its lower part a *sigmoid* (S-like bend), and then becoming the *rectum*, which is the terminal part of the bowel. The lower part of the rectum is protected by two sphincters, an internal sphincter not under the control of the will, and an external sphincter controllable by the will. Other voluntary muscles attached to the lower end of the alimentary canal, and to the bones at the lower margin of the pelvis, have an important part to play in the extrusion of the fæces.

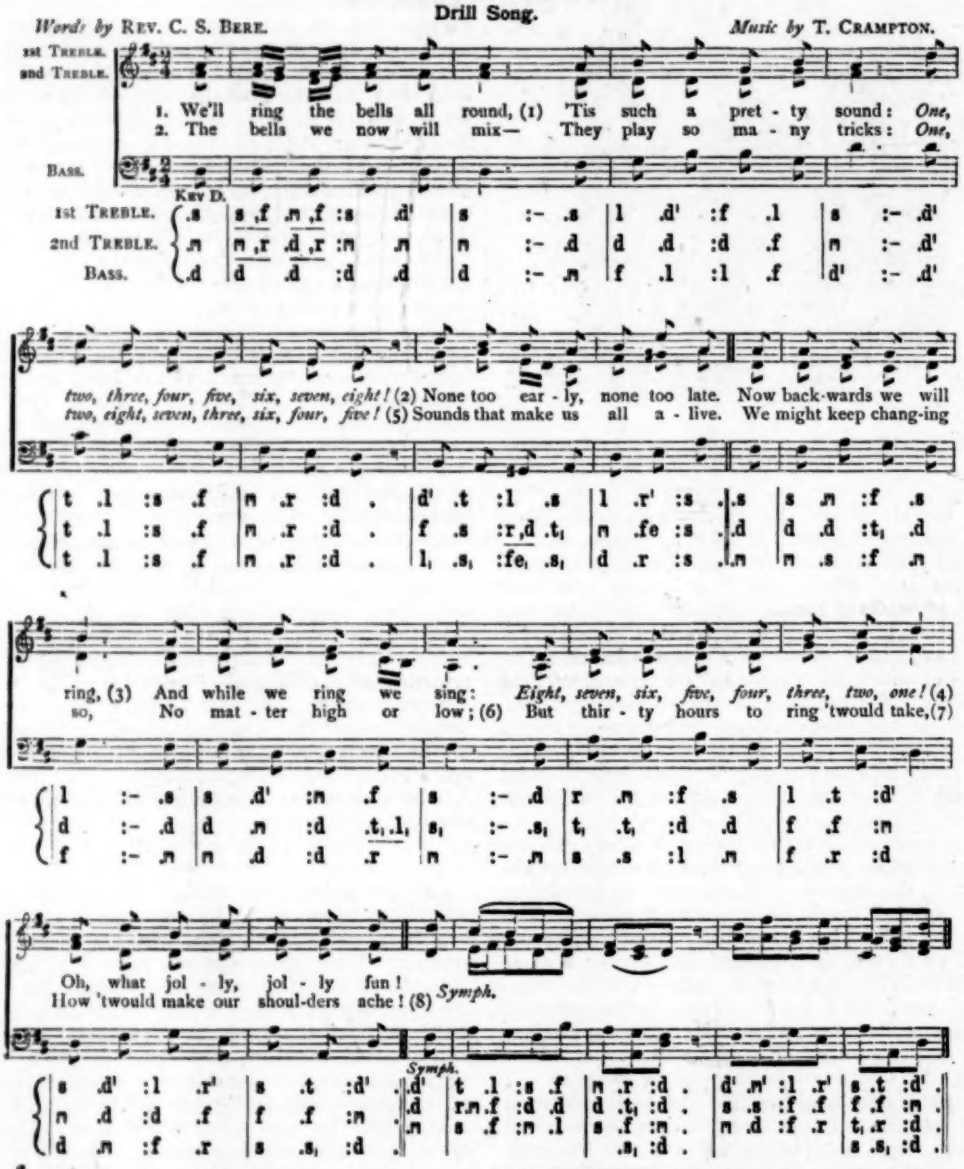
The large intestine has four coats, similar to those of the stomach and small intestine, but differing in minor respects. The *serous* coat is absent over the lower part of the rectum. The *muscular* coat consists, as in the small intestine, of internal, circular, and external longitudinal fibres, but the longitudinal fibres are chiefly collected into three longitudinal bands, except in the rectum, where they spread out over the whole surface of the intestine The *submucous* coat resembles that of the small intestine. The *mucous membrane* differs from that of the small intestine in being smooth and destitute of villi. It presents similar tubular glands to those of the small intestine, only longer and more numerous. Its lymphoid follicles are similar to the solitary follicles of the small intestine, but less prominent.

(*To be continued.*)

GERMAN SCHOOL SINGING.—Mr. J. S. Curwen has published a report on his investigations in elementary schools in Cologne, Munich, Vienna, and Basil, last summer. These towns, in the order in which he happened to visit them, represent an ascending scale of proficiency in singing. The weak point of the whole is that the study of even the elements of musical notation is postponed until the child is ten years of age, and has probably been singing by ear, in the Kinder-Gartens and lower standards, for six or seven years. By this means the habit of trusting to the ear is formed, and even the elder children, who understand the powers of the notes, and hold the music in their hands, prefer to sing by ear. Such a state of things contrasts unfavourably with the Tonic Sol-fa system, by which children of five may, without any strain, be taught to associate sign and sound in an intelligent manner. Mr. Curwen speaks highly of the artistic results obtained. The singing is chiefly done by ear, and the pieces are prepared with much labour, but they are beautifully finished in style. In Switzerland the teaching of notation is well graded, and fair results are obtained.

THE BELLS!

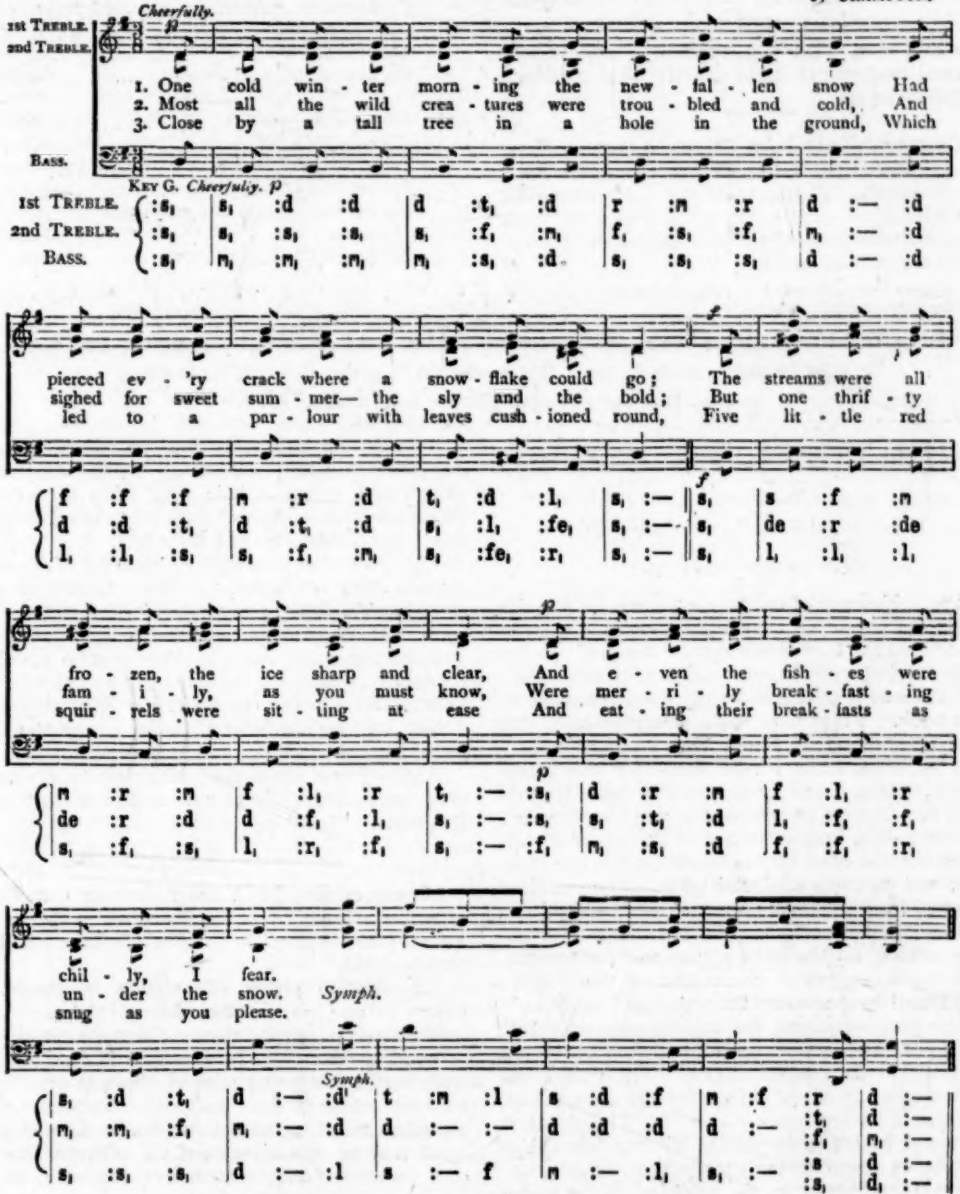
Drill Song.

Words by REV. C. S. BERE. *Music by* T. CRAMPTON.

1st TREBLE.
2nd TREBLE.
BASS.
1. We'll ring the bells all round, (1) 'Tis such a pret - ty sound: One,
2. The bells we now will mix— They play so ma - ny tricks: One,
Key D.
two, three, four, five, six, seven, eight! (2) None too ear - ly, none too late. Now back-wards we will
two, eight, seven, three, six, four, five! (5) Sounds that make us all a - live. We might keep chang-ing
ring, (3) And while we ring we sing: Eight, seven, six, five, four, three, two, one! (4)
so, No mat - ter high or low; (6) But thir - ty hours to ring 'twould take, (7)
Oh, what jol - ly, jol - ly fun!
How 'twould make our shoul-ders ache! (8)
Symph.

(1) Hold up hands, left over right, as if at bell-ropes. (2) If there be eight scholars, bring down hands in order; if sixteen, two at each pull. (3) As in (1). (4) As in (2), only backwards. (5) Ditto. (6) Hands first up, then down. (7) Motion of surprise. (8) Rub shoulders.

THE SQUIRRELS.*

A Winter Song.

T. CRAMPTON.

Cheerfully.
1st Treble.
2nd Treble.
Bass.
1. One cold win - ter morn - ing the new - fal - len snow Had
2. Most all the wild crea - tures were trou - bled and cold, And
3. Close by a tall tree in a hole in the ground, Which
Key G. Cheerfully.
pierced ev - 'ry crack where a snow - flake could go; The streams were all
sighed for sweet sum - mer— the sly and the bold; But one thrif - ty
led to a par - lour with leaves cush - ioned round, Five lit - tle red
fro - zen, the ice sharp and clear, And e - ven the fish - es were
fam - i - ly, as you must know, Were mer - ri - ly break - fast - ing
squir - rels were sit - ting at ease And eat - ing their break - fasts as
chil - ly, I fear.
un - der the snow.
snug as you please.
Symph.

*The teacher will suggest a few appropriate actions to the words of this song.

The Practical Teacher.

A MONTHLY EDUCATIONAL JOURNAL.

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Vol. I. of the *Practical Teacher* is now out of print.

The New Class-Subject, 'Elementary Science.'

(What to teach, and how to teach it.)

BY RICHARD BALCHIN.

IN last month's issue of this magazine will be found a syllabus of a course of sixty lessons on this subject, for Standard III. It is assumed that 'Hughes' Science Readers' will be used in conjunction with this course, for the syllabus is arranged mainly upon the contents of that book. I may here state, parenthetically, that I have been asked by letter, this week, whether I 'know for certain that H. M. Inspector will accept this book, seeing that it does not in its present form contain 120 pages of printed matter and sixty lessons.' In answer to this, I reply that one of the largest schools in South London takes Elementary Science as one class-subject and uses this particular book. The examiner questioned from the book; was delighted with it, and with the intelligence shown in the boys' answers; gave 'excellent' for the merit grant; and, furthermore, the School-management Committee of the London School Board have assessed the report as 'excellent.'

I now propose giving the subject-matter, or bare outlines, of the easy conversational lessons in the syllabus to which I have alluded. The reader will observe that many of the titles have already appeared in the plan of lessons for Standard II. This apparent repetition is, however, inevitable. The teacher will, of course, know how to expand the subject, so as to suit the general intelligence of the children in this higher standard.

LESSON 1.—'THE THREE KINGDOMS.'

Objects exhibited: Pictures of trees and animals. A few stones. A flower growing in a flower-pot, and a tumbler of water.

Animals and vegetables live, feed, and die, *i.e.*, are *animate*. Minerals, *in*animate. Distinguish between animal and vegetable life: (1) As to the nature of their respective foods; (2) As to mode of obtaining that food; (3) Other points of difference.

Vegetable food is inorganic, or earthy; *i.e.*, mineral. Animal food is organic. Animals wander in search of food. Vegetables must have it supplied on the spot. (If the plant in the flower-pot is withering for want of water, *i.e.*, dying of thirst, it is no use placing a tumbler of water by its side; but a thirsty boy can walk *to* the tumbler, reach out his hand and drink.) Plants are never warmer than the air around them; living animals are.

Note.—These distinctions, although open to exception, yet embody sufficient truth for our present purpose.

LESSON 2.—CLASSIFICATION.

Objects exhibited: A chart showing classification of natural objects: this was described in Standard II. lessons; and is given on p. 59 of 'Science Reader for Standard III.'

Classification places *like* objects in groups. An object in one class is like others in that class, but unlike those in other classes. Carry the classification of words further than in Standard II., but adopt the same method of using slips of paper as described in a former article of the PRACTICAL TEACHER. Give a classification of an object for which the neighbourhood may be specially noted, *i.e.*, different kinds of coal; or of iron ore; or of skins for tanning, etc.

LESSON 3.—THE MINERAL KINGDOM: ROCKS AND METALS.

Objects exhibited: Specimens of stones and of metals. Pictures of a stone quarry, *i.e.*, the slate quarries at Penryn; and of a metalliferous mine, *i.e.*, a Cornish tin-mine.

Distinguish between a stone and a metal. A metal (*i.e.*, lead) malleable; fusible; cut-surface bright; same composition throughout its mass; occurs in ores in *veins* or *lodes*. These are cracks in rocks into which has filtered water containing the metalliferous substance in solution. Contrast with rock-masses in these particulars.

LESSON 4.—SANDSTONE.

Objects exhibited: Specimens of different kinds of sandstone; (1) coarse, *i.e.*, millstone grit; (2) fine, *i.e.*, stones for sharpening tools; hammer, and slab of stone.

Sandstone; why so called. Powder up a piece of paving-stone to sand. How formed; show the lines of deposit along the broken edge of the sandstone. The lines are probably lines of mica. Show how this happens, thus:—mix some finely-divided mica with a handful of sand; throw a portion of the mixture into a large glass jug of water: note how the sand settles first; then the mica, which forms a *layer* on the sand. Now throw in the remaining part of the mixture: the sand settles on the previously-formed layer of mica, and so on.

Red sand; white sand (for glass making).

LESSON 5.—GRANITE.

(The notes of this lesson have already been fully given in Standard II. course.)

LESSON 6.—LIMESTONE.

Objects exhibited: Specimens of Bath and Portland oolites. Chalk, white marble, Kentish rag, etc. Some spirits of salts (H.Cl.). Pictures of chalk pit, and of limekiln.

Limestone; why so called, *i.e.*, when burnt, it forms quicklime. Bad air burnt out. Show picture of limekiln. Pour some H.Cl. on a piece of limestone, bad air comes out in bubbles. (If the class is tolerably intellectual, use the terms carbon dioxide, or carbonic acid gas, instead of 'bad air.') Not good to live near a limekiln; why? Lime used in making mortar—bad mortar has little lime—and in the smelting of iron. Chalk is very soft limestone; sometimes find shells and corals, even sharks' teeth, in chalk; this teaches how chalk is formed. So lead to the formation of beds of limestone.

LESSON 7.—SLATE.

Objects exhibited: Small block of slate, to be split up. Slate pencil. Some powdered slate. Picture of slate quarry. If possible, a piece of slate with the fossil named 'a trilobite.'

Show picture, and carry on a conversation about it. Split up a piece of slate into plates. Uses:—roofs of houses, cisterns, etc. Mix some water with powdered slate and so make a 'mud,'—some 'gutter' boy will be glad to do this. Slate was originally like this mud. Show the remains of a sea animal in a block of slate; and thus lead to the formation of slate.

Note.—The subject-matter of Lessons 8, 9, 10, and 11 is fully given in Chapter III. of the 'Science Reader.'

LESSON 12.—IRON.

Objects exhibited: Specimens of cast-iron, wrought iron; iron-ore, slag, mountain-limestone. Pictures of iron-mine, and of a blast furnace.

Iron ores. Hæmatite; black-band, clay-band; operations—(1) Roasting the ore. (2) Smelting. Materials for blast-furnace mixed in the following proportion:—Roasted black band, 4½ cwt.; Roasted clay-band, 4½ cwt.; Limestone—as a flux—2 cwt.; coal, 10 cwt. Pig or cast-iron produced. (3) Puddling, *i.e.*, removal of carbon from cast-iron; and so wrought iron is produced.

Note.—These processes are described in Chapter VII. of the 'Science Reader for Standard IV.'

LESSON 13.—TIN.

Objects exhibited: Specimens of the various kinds of tin-ore; of the pure metal; of sheet-tin. Picture of a Cornish tin-mine.

Show specimen of ore, *i.e.*, a heavy grey stone—tin-stone: sometimes red—red tin-ore. Explain a metallic vein as before. In Cornwall the cracks are generally in granite; sometimes the cracks cross each other. The tin-ore is first washed in a stream of water; then broken up small in the stamping mill; then again washed in water: then the ore is 'roasted' in a furnace where only the *flame* of the furnace comes in contact with the ore; the heat not being sufficient to melt the metal. Lastly, the roasted ore goes to the smelting furnace, where the nearly pure tin is melted out of the ore and sinks to the bottom of the furnace.

Tin is used in alloys; *i.e.*, bronze, bell-metal, solder. Mostly, however, in the manufacture of sheet-tin; or rather iron plates covered with tin. The tin does not cover the iron as a separate coating, but partly enters into its substance as an alloy.

Note.—The subject matter and methods of Lessons 14, 15, 16, and 17 are given with sufficient fulness on p. 30 of the 'Reader.'

LESSON 18.—A PLANT AND ITS PARTS.

Objects exhibited: Four or five pictures of trees, shrubs, and common annuals. A few dried specimens mounted on card-board.

Carry on a conversation about the pictures and specimens. Note that in all of them we have certain parts: *i.e.*, leaves, stems or trunks, small shoots or branches, flowers or seeds, roots, etc. Then describe the parts noticed, in the following order—(1) Root: its use to the plant, and also as food for man and other animals. (2) Stem or trunk; use to the plant, to bear up the leaves and flowers; to man as yielding timber. (3) Leaves; uses to the plant, and also to man. (4) The flowers; uses: the formation of seeds and beautifying the earth.

Note.—The subject-matter of Lesson 19 (the primrose) and Lesson 20 (flowering and flowerless plants) is given on pages 32 to 38 of the 'Reader.'

(*To be continued.*)

ANSWERS TO ALGEBRA QUESTIONS IN 'THE SCHOLAR,' FOR MARCH, 1884.

EXERCISE XXIX.

(1) $x=4,\ y=5$
(2) $x=2,\ y=2$
(3) $x=8,\ y=10$
(4) $x=-1,\ y=1$
(5) $x=4,\ y=5$
(6) $x=2,\ y=1$
(7) $x=7,\ y=4$
(8) $x=3,\ y=4$
(9) $x=5,\ y=7$
(10) $x=30,\ y=41$
(11) $x=10,\ y=9$
(12) $x=3,\ y=5$
(13) $x=5,\ y=2$
(14) $x=10,\ y=13$
(15) $x=44,\ y=35$
(16) $x=3,\ y=2$

ANSWERS TO
Pupil Teachers' Examination Papers.

JANUARY 26.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. $\dfrac{3\frac{1}{2}\text{ of }2\frac{1}{2}-1\frac{1}{2}}{\frac{1}{2}+\frac{1}{3}-\frac{1}{4}}\div\dfrac{2\frac{1}{2}}{2\frac{2}{3}}$

$$\frac{3\frac{1}{2}\text{ of }2\frac{1}{2}-1\frac{1}{2}}{\frac{1}{2}+\frac{1}{3}-\frac{1}{4}}\div\frac{2\frac{1}{2}}{2\frac{2}{3}}=\frac{\frac{1}{2}\text{ of }\frac{1}{2}-\frac{1}{2}}{\frac{1}{2}+\frac{1}{3}-\frac{1}{4}}\div\frac{\frac{1}{2}}{\frac{2}{3}}$$

$$=\frac{\frac{1}{4}-\frac{1}{2}}{\frac{6+4-3}{12}}\div\frac{13\times 8}{5\times 21}$$

$$=(\tfrac{1}{13}\div\tfrac{7}{13})\div\tfrac{104}{105}$$

$$=\frac{481\times 12\times 105}{72\times 7\times 104}=\frac{13}{14}=11\tfrac{9}{16}.\text{ Ans.}$$

2. Convert $\frac{9}{11}$ and $\frac{7}{90}$ into decimals, and then divide the difference of the results by ·00385 to 3 decimal places.

$\frac{9}{11}$ = ·0888888
$\frac{7}{90}$ = ·078125

·00385)·0107638(2·795. Ans.
770
3063
2695
3688
3465
2238
1925
.....

3. Reduce ·7 of £·875 + ·0625 of a crown − ·08$\dot{3}$ of a guinea to the decimal of 13s. 4d.; and find the value of ·76136 of 5 acres 2 roods.

(a)

	£	s.
·875 × ·7 =	12	25
·0625 cr. =		·3125
Sum =		12·5625
Deduct ·08$\dot{3}$ guineas =		1·75
		10·8125

10·8125s. to the dec. of 13s. 4d. $=\frac{10\cdot 8125\text{s.}}{13\frac{1}{3}}$

$$=\frac{32\cdot 4375}{40}$$

$$=\underline{\cdot 8109375}.\text{ Ans.}$$

(b) ·76136 of 5½ ac. $=\frac{3}{4}$ ac. $\times\frac{75375}{99000}$

$$=\frac{11\text{ ac.}\times 8375}{2\times 11000}=\frac{8\cdot 375}{2}\text{ac.}$$

$$=4\cdot 1875\text{ ac.}=\underline{4\text{ ac. }30\text{ po.}}\text{ Ans.}$$

4. A man spends $\frac{3}{11}$ of his money, and then earns 5s.; he afterwards spends $\frac{1}{7}$ of what he then has, and has 10s. 6d. left. How much had he at first?

10s. 6d. = $\frac{1}{7}$ of what he had after earning 5s.

$\therefore\ \dfrac{10\text{s. }6\text{d.}\times 7}{3}=$ " " "

$$=24\text{s. }6\text{d.}$$

Hence 24s. 6d. − 5s. = 19s. 6d. = $\frac{8}{11}$ of what he had at first.

And $\therefore\ \dfrac{19\text{s. }6\text{d.}\times 16}{13}=$ what he had at first.

$$=\underline{\pounds 1\ 4\text{s.}}\text{ Ans.}$$

FEMALES.

1. The books in a case can be arranged in rows of 5, 7, 9, or 15; how many are there?

The number of books is the L.C.M. of these numbers.
And the L.C.M. of 5, 7, 9, and 15 = 315. Ans.

2. Find the value of 219 cwt. 3 qrs. 21 lb. at £1 6s. 8d. per cwt.

	£	s.	d.		
	1	6	8	= value of	1 cwt.
			219		
	292	0	0	= "	219 "
2 qrs. = ½ cwt.	0	13	4	= "	2 qrs.
1 qr. = ½ of 2 qrs.	0	6	8	= "	1 qr.
14 lb. = ½ qr.	0	3	4	= "	14 lb.
7 lb. = ½ of 14 lb.	0	1	8	= "	7 lb.
	293	5	0	= val. of 219 cwt. 3 qrs 21 lbs.	

3. Find the difference between $\frac{4}{9}$ and $\frac{3}{11}$.

$$\tfrac{4}{9}-\tfrac{3}{11}=\frac{44-27}{99}=\tfrac{17}{99}.\text{ Ans.}$$

4. Find the value of 9 yds. 2 ft. 3 in. at 5s. 7d. per yard.

	£	s.	d.		
	0	5	7	= price of	1 yd
			9		
	2	10	3	= " "	9 yds.
1 ft. = ⅓ of a yd.	0	1	10½	= " "	1 ft.
1 ft. = ⅓ " "	0	1	10½	= " "	1 ft.
3 in. = ¼ of 1 ft.	0	0	5$\frac{7}{12}$	= " "	3 in.
	2	14	5½	= price of 9 yds. 2 ft. 3 in.	

5. Find the G.C.M. of 1729 and 5850.

2	1729	5850	3
	1326	5187	
1	403	663	1
	260	403	
1	143	260	1
	117	143	
2	26	117	4
	26	104	
		13	∴ 13 = G C M. Ans.

Grammar.

MALES AND FEMALES.

'His grandeur he derived from Heaven alone,
For he was great, ere Fortune made him so;
And wars like mists that rise against the sun,
Made him but greater seem, not greater grow.

1. Analyse the first two lines of this stanza.

2. Parse the third and fourth lines.

1. ANALYSIS.

Sentence.	Kind.	Subject.	Predicate.	Object.	Extension.	Connective.
1. His grandeur he derived from heaven alone	Principal	he	derived	his grandeur	from heaven alone (*place*)	
2. For he was great	Subord. of cause to (1)	he	was great			for
3. Ere Fortune made him so.	Subord. of time to (2)	Fortune	made so (compl.)	him	so (indirect object or complement)	ere

2. PARSING.

And—copulative conj., connecting the two principal clauses.
wars—abst. noun, neut., plur , nom., subj. of 'made.'
like—predic. adj., qual. 'wars' (some consider 'like' a prep.)
mists—com. noun, neut., plur., obj., gov. by (to), or by 'like' if considered a prep.
that—simple rel., referring to 'mists,' 3rd pers. plur., neut., nom , subj. of 'rise.'
rise—intrans. irreg. verb, *rise, rose, risen*, indic., pres., indef., 3rd pers. plur., agr. with 'that.'
against—prep. showing rel. bet. 'rise' and 'sun,' and gov. the latter.
the—def. art., or dist. adj., limiting 'sun.'
sun—com. noun, neut., sing., obj., gov. by 'against.'
made—trans. irreg. verb, *make, made, made*, indic. past., indef., 3rd pers. plur., agr. with 'wars.'
him—demonst. pron., 3rd pers. sing., mas., obj., gov. by 'made.'
but—adv. of deg. mod. 'seem.'
greater—predic. adj., compar. deg., qual. 'him.'
seem—reg. intrans. verb, infin. pres., indef., gov. by 'made.'
not—neg. adv., mod. 'grow.'
greater—same as above.
grow—irreg. intrans. verb, *grow, grew, grown*, infin. pres. indef.

3. Take the four nouns, Heaven, Fortune, War, and Mist, and show how, by the addition of a syllable, each of them may be turned into an adjective. Give in each case two other words of like construction.

Heaven*ly*,	earth*ly*,	world*ly*.
Fortun*ate*,	passion*ate*,	desper*ate*.
War*like*,	God*like*,	fiend*like*.
Mist*y*,	ston*y*,	wood*y*.

4. Correct, if needful, these sentences, and give your reasons for altering them :—

'What went ye out for to see?'
'I wished to have seen you yesterday.'
'It was not me who did it.'

'What went ye out to see?' *For* should not be used before the infinitive.
'I wished *to see* you yesterday.' The present infinitive, and not the perfect, should be used after a past tense.
'It was not *I* who did it.' The verb *to be* and many intransitive and passive verbs when finite, have a *nominative* both before and after them.

Geography.

(*Answer either Question* 2 *or Question* 3, *not both.*)

1. Draw a full map of the western portion of the Dominion of Canada, including Lake Winnipeg, and all that lies to the west and north of it. Mark the chief mountain heights, rivers, and lakes.
N.B.—Insert the lines of latitude and longitude.

2. Give a short account of London, describing the different parts of it, the physical features of the surrounding country, and the habits and occupations of the people. Say what you know about its history.

The three principal divisions of London are: the City, in which its immense commerce is carried on; Westminster, the seat of the Courts and Parliament; and Southwark, on the south bank of the Thames. It has been so vastly extended as to embrace the adjacent villages (now grown to the size of cities)—Hackney, Islington, Spitalfields, Stepney, Rotherhithe, Camberwell, Kensington, Chelsea, and several others.
London is situated on that part of the Thames, where its basin of low clay is enclosed between ranges of hills, from which smaller streams are thrown down. To the north lie the Chilterns and the East Anglian uplands, to the south the North Downs, and further off the Wealden Heights. The largest part of it stands in Middlesex, the next largest in Surrey, a large part stretches into Kent, and another into Essex. Around it lie large grass farms, numerous market-gardens, and many brick-fields, from the bricks of which the houses of London are built.
It is impossible to speak of the varied occupations of the population of a city containing contributions from all the races and nationalities in the world. Among its people are to be found more wealth, more poverty, more charity, and more misery than can be found in any other single city on the face of the earth.
London existed in Druidical times, long before the arrival of the Romans. It was called Augusta by the Romans, and was the central point from which all the Roman roads in Britain diverged. After the Romans left, it became the capital of the East Saxons, and then that of England under Alfred. It obtained its first royal charter from William the Conqueror in the eleventh century.

3. 'Land of brown heath and shaggy wood!
Land of the mountain and the flood!'

—Which parts of Scotland answer best to this description? Show this by comparing them minutely with other parts of that country and with England.

The parts of Scotland which answer to this description are those lying in the north of the country, and cut off from the southern, or lowland districts, by the irregular masses of the Grampians, which extend from Argyll to Kincardine. No less than three-fourths of the entire surface of the land are covered with masses of gneiss, quartz, granite, and other rocks, which form mountains that in some cases reach to nearly double the height of the English heights, or widen into moorlands that lie 1000 ft. or higher above the level of the sea. The south of Scotland is hilly, but nothing to be compared with the north. The west coast is very much cut up by inlets, called 'lochs,' and these give Scotland a longer coast line, in proportion to its size than England. With the exception of Switzerland there is no country in Europe more remarkable for its lakes. Its highland streams generally partake of the nature of torrents, and when they are flooded their force is terrible.

History.

1. Which were the three dominant Saxon kingdoms? Describe their position.

The three dominant Saxon kingdoms were *Northumbria*, extending from the Firth of Forth to the Humber; *Mercia*, including the land east of the Severn, north of the Thames, south of the Humber; and *Wessex*, including the country west of the present Sussex, south of the Thames, except Devon and Cornwall.

2. Write down a list of sovereigns from Egbert to Athelstan with dates, and give some account of one of them.

		A.D.	A.D.
Egbert	reigned from	827	to 836
Ethelwulf	,, ,,	836	,, 857
Ethelbald	,, ,,	857	,, 860
Ethelbert	,, ,,	860	,, 866
Ethelred	,, ,,	866	,, 871
Alfred	,, ,,	871	,, 901
Edward I.	,, ,,	901	,, 925
Athelstan	,, ,,	925	,, 941

Alfred the Great, fourth son of Ethelwulf, was born at Wantage, in Berkshire. After the death of his three brothers he came to the throne in 871, and during a reign of thirty years he was constantly at war with the Danes. They were successful in making head against him. In 877 he was forced to disband his troops, and he retired to Athelney. During his wanderings the tales of his entering the Danish camp as a harper, and his adventure with the neatherd's wife, who scolded him for letting the cakes burn, etc., are well known. Having learnt the plans of his enemies, he defeated them at Ethandune, 878, recovered possession of London, and devoted himself to the improvement of his kingdom. In 896 he repelled a new Danish invasion, and died in 901.

3. How was the Witan composed, and what powers did it possess?

The Witan among the Anglo-Saxons was composed of Aethelings or princes, ealdormen or nobles, the large landholders, the principal ecclesiastics, etc. It was summoned by the king in any political emergency; and its assent was necessary to give validity to laws; and treaties with foreign states were submitted to its approval; it had even power to elect the king, and if the crown descended in his family, it was by means of the formal recognition of the new king by the nobles, bishops, etc., in an assembly convened for the purpose.

Dictation.

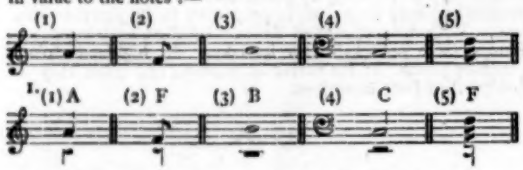
For Pupil-Teachers at the end of the 'First Year.'

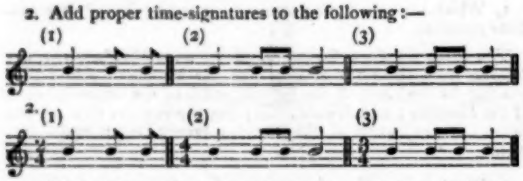
The following dismal description is given of the life of our primitive ancestors in Friesland, before the erection of their dykes and embankments against the German Ocean. 'Twice a day the tide rolls in and covers the land. The miserable natives get upon hillocks, or on artificial banks, which they have made after finding how high the water will rise. In their huts upon their banks they look, when the tide is in, like sailors on board ship, and like shipwrecked men when the tide ebbs; and round their huts they hunt the fish as they try to escape with the tide. They have no cattle, so that they cannot live on milk like other wild nations; nor can they even fight with wild beasts, when every stick is swept out to sea. They weave fishing-nets out of sea-tangle and rushes; and they pick up handfuls of mud, which they dry in the wind (for they have little sunshine), and so make a fire to scorch their food and to warm their stiffened bodies.'

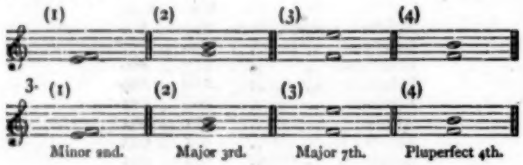
Music.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write above each of the following notes its pitch-name (C, D, &c.); and below write the signs for rests corresponding in value to the notes:—

2. Add proper time-signatures to the following:—



3. Write below each of the following intervals its name (major fourth, &c.):—

TONIC SOL-FA NOTATION.

1. Write (1) a six-pulse tone, using two-pulse measure; and (2) a six-pulse tone, using three-pulse measure.

1. (1) |l :— |— :— |— :— ‖
(2) |l :— :— |— :— :— ‖

2. Write the names of the following intervals:—(1) *fah* to *me*; (2) *soh* to *te*; (3) *fah* to *me*^{1}; (4) *fah* to *te*.

2. (1) Minor 2nd; (2) Major 3rd; (3) Major 7th; (4) Pluperfect 4th.

3. Write the following an octave higher, and state what is meant by the direction "Key G":—

Key G.
|d :s |m :f |s :l |r :s |m :— ‖

3. Key G.
|d^1 :s^1 |m^1 :f^1 |s^1 :l^1 |r^1 :s^1 |m^1 :— ‖

"Key G" means that after sounding C^1 on the pitch-fork, we are to run down the scale to G, and take that as the *doh* of the tune, which is written in the "Key of G," as it is called.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed for this Paper.

MALES.

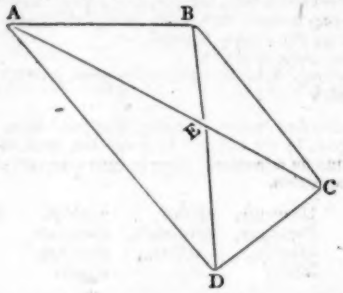
Euclid.

All generally understood abbreviations for *words* may be used.

1. The angles at the base of an isosceles triangle are equal to each other; and if the equal sides be produced, the angles on the other side of the base shall be equal.
Prop. 5, Bk. I.

2. If two straight lines cut one another, the vertical, or opposite angles shall be equal.
Prop. 15, Bk. I.

3. The four sides of any quadrilateral are together greater than the two diagonals, and less than twice the two diagonals.



In the quadrilateral ABCD, AB, BC are greater than AC (I. 20); BC, CD greater than BD; CD, DA greater than AC; DA, AB greater than BD. That is, twice AB, BC, CD, DA are greater than twice AC, BD; or AB, BC, CD, DA are together greater than the two diagonals AC, BD.

Again, let the two diagonals cut one another in the point E, then (I. 20) DE, EC are greater than DC; CE, EB greater than BC; BE, EA greater than AB; and AE, ED greater than AD; or twice AC, BD are greater than the sides AB, BC, CD, DA; that is, the four sides of the quadrilateral are together less than the two diagonals. Q. E. D.

Arithmetic.

FEMALES.

1. Express $\frac{1}{8}$ of 2s. 6d. + $\frac{1}{4}$ of a guinea + $\frac{1}{5}$ of £1 − $\frac{1}{10}$ of penny as the fraction of £5.

	d.
$\frac{1}{8}$ of 2s. 6d.	$= 11\frac{1}{4}$
$\frac{1}{4}$ of a guinea	$= 201\frac{3}{5}$
$\frac{1}{5}$ of £1	$= 400$
	$612\frac{17}{20}$
deduct	$\frac{1}{10}$
	$612\frac{3}{4}$

$612\frac{3}{4}$d. to the fraction of £5 $= \frac{612\frac{3}{4}\text{d.}}{£5}$

$= \frac{2451 \text{ far.}}{4800 \text{ far.}} = \frac{817}{1600}$ of £5. Ans.

2. What fraction of $2\frac{1}{2}$ cwt., together with 3 qrs. 14 lbs., will give a ton and a half?

Fraction required $= \frac{1 \text{ ton } 10 \text{ cwt.} - 3 \text{ qrs. } 14 \text{ lbs.}}{2\frac{1}{2} \text{ cwt.}}$

$= \frac{30 \text{ cwt.} - 3\frac{1}{2} \text{ qrs.}}{2\frac{1}{2} \text{ cwt.}}$

$= \frac{29\frac{1}{2} \text{ cwt.}}{2\frac{1}{2} \text{ cwt.}} = \frac{233}{250}$. Ans.

3. Reduce to a decimal $\frac{7\cdot75}{9}$ of $\frac{2\frac{1}{2}}{2\frac{1}{5}}$ of $\frac{3\frac{1}{3}}{3\frac{1}{11}}$.

$\frac{7\cdot75}{9}$ of $\frac{2\frac{1}{2}}{2\frac{1}{5}}$ of $\frac{3\frac{1}{3}}{3\frac{1}{11}} = \frac{7\frac{3}{4}}{9} \times \frac{2\frac{1}{2}}{2\frac{1}{5}} \times \frac{3\frac{1}{3}}{3\frac{1}{11}}$

$= \frac{31}{12} \times \frac{5}{11} \times \frac{10}{33}$

$= \frac{1}{2} = \cdot 5$. Ans.

4. What part of £9 is ½ of $\frac{9}{10}$ of half-a-crown?

$$\frac{\frac{1}{2}\text{ of }\frac{9}{10}\text{ of 2s. 6d.}}{£9} = \frac{2\frac{1}{2}\text{s.} \times 9 \times 1}{2 \times 10} \text{ 180s.}$$

$$= \frac{5 \times 9 \times 1}{2 \times 2 \times 10 \times 180.} = \frac{1}{144}. \text{ Ans.}$$

Grammar.

MALES AND FEMALES.

'At the close of the day, when the hamlet is still,
And mortals the sweets of forgetfulness prove,
When nought but the torrent is heard on the hill,
And nought but the nightingale's song in the grove;
'Twas thus, by the cave of the mountain afar,
While his harp rang symphonious, a hermit began;
No more with himself or with nature at war,
He thought as a sage, though he felt as a man.'

BEATTIE.

1. Paraphrase the above extract.
2. Analyse the last four lines.
3. Parse the first and second lines.

1. 'In the evening, when the day's labours are over; when the village and its inhabitants are hushed in repose; when silent is everything, except the distant gush of the mountain stream, or the note of some night-bird in the woodland,'—In the above strain did the recluse, who passes his life apart from his fellow-creatures, begin to sing, while he accompanied his voice with the harp. He had reached that happy stage of his life when he is at peace with himself and all things, while at the same time sympathising with the failings of mankind.

ANALYSIS.

Sentences.	Kind.	Subject.	Predicate.	Extension.	Connective.
(1) 'Twas thus	Principal	it	was thus		
(2) By the cave of a mountain afar a hermit began,	Subord. noun to (1)	a hermit	began	by the cave of a mountain afar (*place*)	(that)
(3) While his harp rang symphonious.	Subord. adv. to (2)	his harp	rang	symphonious (*manner*)	while
(4) No more with himself or with nature at war, he thought	Principal	he no more . . . at war	thought	sent. (5) (*manner*)	
(5) as a sage (thinks),	Subord. adv. to (4)	a sage	(thinks)		as
(6) though he felt	Subord. adv. to (4)	he	felt	sent. (7) (*manner*)	though
(7) as a man (feels).	Subord. adv. to (6)	a man	(feels)		as

PARSING.

at—prep., gov. obj. case 'close.'
the—def. art. or dist. adj. defining 'close.'
close—abstr. noun, neut., sing., obj., gov. by 'at.'
of—prep. showing relation between 'close' and 'day.'
the—same as above, defining 'day.'
day—abstr. noun, neut., sing, obj. gov. by 'of.'
when—subord. temporal conj., introd. subord. adv. sent.
the—as above, defining 'hamlet.'
hamlet—com. noun, neut., sing., nom., subj. of 'is.'
is—irreg. intrans. verb, *am*, *was*, *been*, indic., pres., indef., 3rd pers. sing. agr. with 'hamlet.'
still—predic. adj. qual. 'hamlet.'
and—copulative conj. connecting two subord. sentences.
mortals—com. noun, mas., plur., nom., subj. of 'prove.'
the—as above, defining 'sweets.'
sweets—abstr. noun, neut., plur., obj. gov. by 'prove.'
of—prep. showing the relation between 'sweets' and 'forgetfulness.'
forgetfulness—abstr. noun, neut., sing., obj. gov. by 'of.'
prove—reg. trans. verb, indic. pres. indef., 3rd pers. plur. agr. with 'mortals.'

4. Make three sentences each containing a relative pronoun in the objective case.

1. This is a passage *which* I have seen before.
2. He is a person *whom* I have met often.
3. There is the man *that* I gave the letter to.

5. In these words, Receiver, Recipient, Receptive, Reception, and Receivable, point out the use of the final syllable, and the effect it has on the meaning of the word.

FINAL SYLLABLE.	EFFECT.	USE.
—er	means an actor	forms nouns
—ent	,, ,,	,, ,,
—ive	,, 'inclined' to	,, adjectives
—tion	,, state or condition	,, abstract nouns
—able	,, able to be	,, adjectives

Geography.

Answer Two Questions.

1. Draw a map showing the course of a vessel, keeping close to the coast, from the mouth of the Loire to the mouth of the Vistula. Mark islands, seaports, straits, and river mouths.
N.B.—Insert the lines of latitude and longitude.

2. Give a short account of the differences of climate in the different parts of Great Britain and Ireland; and give reasons for these differences.

As all parts of the British Isles are bathed in the same sea-winds, so all share alike in the advantages they bring; and there is scarcely any difference between the winter climate of the southern coast of Britain and that of the Shetlands in the far north. The prevailing wind is from the west, and this wind, laden with the moist vapours of the ocean which it has traversed, first breaks upon Ireland; and hence the climate of this island is damper than that of the rest of the British group. As the western mountain chains of Ireland are comparatively low, the rainclouds are not effectually caught by them, and so distribute their moisture more evenly over the whole surface of the country than in the island of Great Britain. In Britain, on the other hand, the mountains of the west are high enough to intercept a large proportion of the moisture borne along by this wind, and thus a belt of rainy country extends along Western Britain. The rainfall on the eastern plains is, however, very considerable, and thus this abundant supply of moisture, co-operating with a moderate climate, promotes the fertility of the British Islands.

3. Describe fully the physical and political features of the basin of the Indus.

The basin of the Indus is very fertile, but wants cultivation. The best portion is that near the Himalaya range, which is the most favourable district in India for the growth of corn. The Indus and its four tributaries give name to 'the Punjab,' the greater part of which is naturally divided into Doabs formed by the rivers by which it is intersected. This country is very fertile when cultivated, and produces rice, cotton, indigo, tobacco, hemp, etc. Since 1859 much has been done for the Punjab by the construction of roads, canals, railways, etc., to develop its resources. The chief towns in its basin are Cabool, Peshawur, Lahore, Umritsir, Mooltan, Aliwal, Hyderabad, Tattah, and Kurrachee. Sinde, a division of the Bombay Presidency, lies in the lower valley and delta of the Indus. This river, like the Ganges, is subject to annual floods; and as the banks are low, the country is frequently widely inundated, when sometimes villages and even towns are washed away.

Needlework.

Two hours and a half allowed.

FEMALES.

The needlework specimens will be collected by the Inspector at the expiration of one hour after the distribution of the examination papers.

Arithmetic.

MALES.

1. If a man invests £4065 in 4½ per cent. debentures at 135½, what dividend will he get, the usual brokerage being charged?

£4½ is got from 135½ + ½ or 135½
∴ £135½ : £4065 :: £4½ : dividend.

$$\frac{£4\frac{1}{2} \times 4065}{135\frac{1}{2}} = \frac{£9 \times 4065}{271} = £135. \text{ Ans.}$$

2. In what time will £960 12s. 6d. amount to £1052 16s. 10½d. at 4 per cent. per annum, simple interest?

Interest = (£1052 16s. 10½d. − £960 12s. 6d.) = £92 4s. 4½d.

£4	:	£92	4s.	4½d.
20		20		
80		1844		
12		12		
960		22132		
5		5		
4800		110664		

£960½ : £100 :: 1 yr. : time

$$\frac{1 \text{ yr.} \times 110664 \times 100}{4800 \times 960\frac{1}{2}} = \frac{110664 \times 8}{48 \times 7685} \text{ yrs.}$$

$$= \frac{14}{7}\frac{4}{6}\frac{4}{8}\frac{4}{5} \text{ yrs.}$$

$$= 2\tfrac{2}{7}\tfrac{4}{6}\tfrac{4}{8} = 2\tfrac{4}{7} \text{ yrs.} \quad \text{Ans.}$$

3. A farmer buys 25 sheep at £2 5s. each, and 15 at £2 2s. each; he keeps them for a month at a cost of 5s. each, and sells them all at £2 15s. 6d. each. What is his average gain per sheep?

	£	£ s.
25 sheep at	2¼	= 56 5
15 „ „	2 1/20	= 31 10
		87 15
40 „ „	¼	= 10 0
Total cost		= 97 15
40 sheep sold at £2 15s. 6d. ea.		= 111 0
Gain on 40 sheep		= 13 5
„ ea. „		= 6 7½d. Ans.

4. A man divided his property amongst his three sons in the proportion of ⅖, 1 7/20, and ⅜. What percentage of the property did they respectively get? (Correct to two decimal places.)

$$\tfrac{2}{5} + 1\tfrac{7}{20} + \tfrac{3}{8} = \frac{72+50+45}{120} = 1\tfrac{67}{120} \text{ shares.}$$

$$167 : \begin{Bmatrix} 72 \\ 50 \\ 45 \end{Bmatrix} :: 100 \begin{cases} 43{\cdot}11 \text{ p.c. of 1st. Ans.} \\ 29{\cdot}94 \text{ „ 2nd. Ans.} \\ 26{\cdot}94 \text{ „ 3rd. Ans.} \end{cases}$$

History.

MALES AND FEMALES.

1. What measures of improvement make the reign of Henry II. memorable? What sorrows and reverses attended his death?

As soon as Henry II. was crowned, he set himself in good earnest to reform the country. He speedily reduced the turbulent nobility to some degree of submission; and at the great council of the nation, held at Clarendon, he procured the passing of laws or constitutions which brought the clergy under his control, and deprived the pope of his chief advantage for troubling England. He thought to have got Becket to side with him in these reforms, but this churchman turned against him. The murder of Becket brought humiliation upon Henry, and he suffered penance and flagellation at his tomb. Various circumstances in Wales, France, and Ireland gave Henry an opportunity of extending his dominions, so that he became the most powerful monarch in Europe. But now he was doomed to domestic trials; his sons rebelled, and joined with the French king and his own nobility in taking up arms against him. His own queen aided them; repeated treaties were made and broken; and at last the unhappy king saw his youngest and favourite son John forsake him, and, brokenhearted, he died 1189.

2. Who was Simon de Montfort? Are we under any obligations to him?

Simon de Montfort, Earl of Leicester, was the leader of the rebellious barons in their attacks on Henry III., which led to the victory of Lewes. He subsequently summoned the representatives of the freeholders and burgesses in such a way as to lay the foundation for the existence and the authority of our House of Commons. He fell in the same year, 1265, in battle at Evesham, when Prince Edward was conqueror, and Henry III. was delivered from captivity.

2. How did Henry VII. come to the throne? Sketch his reign, and suggest a reason why among the historical plays of our great poet none relate to this period.

Henry VII., the first monarch of the Tudor dynasty, the overthrower and suecessor of Richard III., was descended from John of Gaunt on his mother's side, and from the widowed queen of Henry V. on his father's; and thus embodied all the claims of the House of Lancaster. He was an exile in France when the Duke of Buckingham invited him to join in a rising against the usurper Richard III. Buckingham rose before Henry reached England, and was defeated, captured, and executed. Henry landed in Wales, met Richard at Bosworth, gained the victory, and his opponent was slain. In order to strengthen his title to the throne, he, after some delay, married Elizabeth, the eldest daughter of Edward IV., thus bringing to an end the disastrous rivalry of the Houses of York and Lancaster. But he was not allowed to retain his throne wholly in peace. After a feeble effort by an English nobleman, the Duchess of Burgundy, sister of Edward IV., obtained one Lambert Simnel to personate a brother of Richard III. He was defeated in a decisive battle and made a turnspit. Six years after appeared another claimant to the throne, claiming to be the young Duke of York who was said to have been murdered in the Tower. He received support from all the Yorkists, and from the Scottish king, but he also was unsuccessful, and was afterwards executed along with that Earl of Warwick whom Simnel pretended to be. A pretended war with France, and the marriage of the Princess Margaret Tudor to James IV., King of Scotland, from which marriage sprang the unhappy race of Stuarts, are the only other events of importance.

Lord Bacon wrote a fine history of this king to please James I., but Shakespear may have thought him not worthy of a play, or perhaps he did not think it wise to meddle with the founder of the Tudor dynasty while living under his great descendants, Elizabeth and James.

Teaching.

What are the advantages of ruling the slates of very young children in triple lines for teaching writing? Give a specimen of a copy so set as to show the use of the three lines.

The great advantages of ruling the slates with three lines are, showing where (1) some of the letters are to be begun, (2) how high they are to go, and (3) how far down they are to go. For example, *o* begins on the middle line, proceeds to the top line, exactly touches it, curves down to the bottom line, exactly touches it, and joins the first part of the letter on the middle line. In making *n* we commence on the middle line, make a curve to the right exactly touching the top line, and bring the downstroke to the bottom line, thus making the first part of the letter *n*. The second part of the *n* commences on the middle line, goes up to the top line, makes a bold curve touching the top line, comes as a downstroke and forms another curve touching the bottom line, and finishes on the middle line. The capitals may be taught by means of the three lines in a similar way.

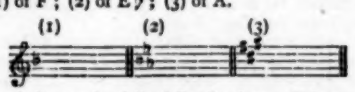
Music.

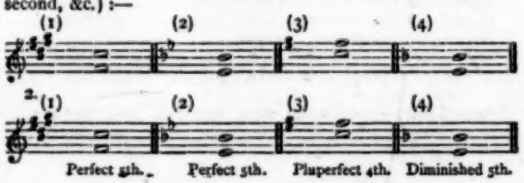
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

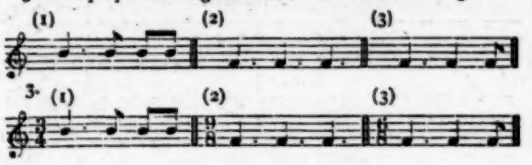
1. Write the key-signatures of each of the following major keys:—(1) of F; (2) of E♭; (3) of A.

1. (1) (2) (3)



2. Write below each of the following intervals its name (major second, &c.):—

Perfect 5th. Perfect 5th. Plaperfect 4th. Diminished 5th.

3. Add proper time-signatures to each of the following :—



3. (1) (2) (3)

TONIC SOL-FA NOTATION.

1. Write the names of the following intervals :—(1) *lah* to *me* ; (2) *doh* to *fah* ; (3) *te* to *fah* ; (4) *fah* to *te*.

1. (1) Perfect 4th ; (2) Perfect 5th ; (3) Pluperfect 4th ; (4) Diminished 5th.

2. What is the mental effect (1) of *fah* ? (2) of *me* ? (3) of *lah* ?

2. (1) Awe-inspiring ; (2) calm and peaceful ; (3) mournful.

3. What are the five kinds of measure most commonly used ?

3. Two-pulse ; three-pulse ; four-pulse ; six-pulse ; and nine-pulse.

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on or after 1st May,* 1878 ; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Euclid.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including Question 3, *if you can.*

MALES.

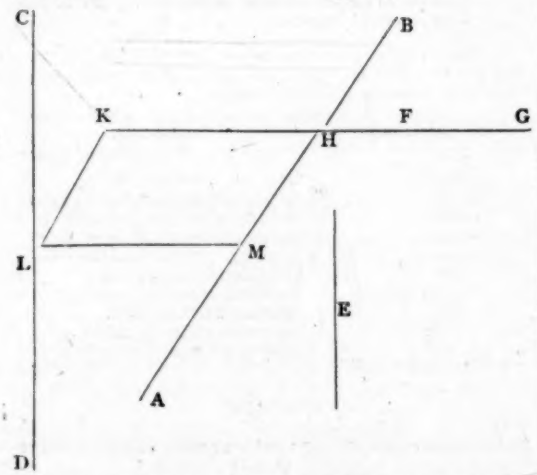
1. If a side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles ; and the three interior angles of every triangle are together equal to two right angles.

Prop. 32, Bk. I.

2. The complements of the parallelograms which are about the diameter of any parallelogram are equal to one another.

Prop. 43, Bk. I.

3. Between two given straight lines it is required to draw a straight line which shall be equal to one straight line and parallel to another.



Let AB, CD be the two given straight lines ; it is required to draw a straight line between AB and CD equal to E, and parallel to FG.

Produce GF to K, meeting AB in H, and make HK = E.
Through K draw KL, meeting CD in L.
Through L draw LM parallel to KH (that is FG), meeting AB in M.
LM is the straight line required.
By construction the figure KHML is a parallelogram, and (I. 34) its opposite sides are equal. ∴ LM = KH, and KH was made equal to E. ∴ LM = E, and LM is drawn parallel to FG between AB and CD. Wherefore LM is the straight line required. Q. E. F.

N.B.—H may be taken anywhere in either line, and HK drawn parallel to FG and equal to E, with same result.

Algebra.

Answer two Questions.

1. Divide the product of $a+b-c$, $a-b+c$, and $b+c-a$ by $a^2-b^2-c^2+2bc$.

$$\frac{(a+b-c)(a-b+c)(b+c-a)}{(a^2-b^2-c^2+2bc)} = \frac{\{a+(b-c)\}\{a-(b-c)\}(b+c-a)}{(a^2-b^2-c^2+2bc)}$$
$$= \frac{a^2-(b-c)^2(b+c-a)}{(a^2-b^2-c^2+2bc)}$$
$$= \frac{(a^2-b^2-c^2+2bc)(b+c-a)}{(a^2-b^2-c^2+2bc)}$$
$$= \underline{b+c-a}. \text{ Ans.}$$

2. Find the L.C.M. of $x^3-9x^2+26x-24$, $x^3-10x^2+31x-30$, and $x^3-11x^2+38x-40$.

($x-2$ is a factor of each expression)

$x^3-9x^2+26x-24=(x-2)(x^2-7x+12)=(x-2)(x-4)(x-3)$
$x^3-10x^2+31x-30=(x-2)(x^2-8x+15)=(x-2)(x-3)(x-5)$
$x^3-11x^2+38x-40=(x-2)(x^2-9x+20)=(x-2)(x-4)(x-5)$
∴ L. M. C. $=\underline{(x-2)(x-3)(x-4)(x-5)}$. Ans.

3. Find two consecutive numbers, the difference of their squares being 57.

Let x = the one number.
Then $x+1$ = the other
$\therefore (x+1)^2-x^2=57$
$x^2+2x+1-x^2=57$
$2x=57-1$
$2x=56$
$x=\underline{28}$

Hence the numbers are $\underline{28}$ and $\underline{29}$. Ans.

Mensuration.

Find the rent of a triangular field whose sides are $7\frac{1}{2}$, $8\frac{1}{4}$, and $10\frac{3}{4}$ chains at 45s. per acre.

$\frac{1}{2}$ sum of sides $= 13\frac{1}{2}$ chains.

$\therefore$ area of $\Delta = \sqrt{13\frac{1}{2}\times 5\frac{3}{4}\times 5\times 2\frac{1}{4}}$
$= \sqrt{\frac{27}{2}\times\frac{23}{4}\times 5\times\frac{9}{4}}$
$= \sqrt{\frac{23\,23\,7\,4}{2\,2\,4\,4}}$
$= \sqrt{952{\cdot}34375}$
$= 30{\cdot}86$ sq. chains
$= 3{\cdot}086$ ac.

$3{\cdot}086$ ac. at £$2\frac{1}{2}$ each $=$ £$6{\cdot}943 = \underline{£6\ 18s.\ 10\frac{1}{2}d.}$ nearly. Ans.

Arithmetic.

FEMALES.

1. Express $\frac{1}{8}$ of half-a crown $+\frac{1}{5}$ of a shilling as a decimal of 7s. (to 4 places of decimals).

	s.
$\frac{1}{8}$ of 2s. 6d. $=\frac{1}{8}$ of 2·5s.	$= {\cdot}9375$
$\frac{1}{5}$ of 1s.	$= {\cdot}8$
	$= 1{\cdot}7375$s.

and 1·7375s. to the dec. of 7s. $= \frac{1{\cdot}7375}{7}$
$= \underline{{\cdot}2482\ldots}$s. Ans.

2. Find the value of ·75 of 6s. 8d. − 1·84375 of 4s. + 3·9796 of 2s.

	s.
·75 of 6s. 8d. = $6\frac{2}{3} \times \cdot 75$ =	5·0000
+ 3·9796 of 2s. =	7·95$9\frac{3}{4}$
Sum =	12·95$9\frac{3}{4}$
− 1·84375 of 4s. =	7·375
Remainder =	5·58$4\frac{3}{8}$s.
	12
	7·012d.

∴ The value = 5s. 7·012d. Ans.

3. A owned $\frac{4}{17}$ of a vessel and sold $\frac{3}{11}$ of $\frac{2}{3}$ of his share for £$\frac{400}{33}$; what was the value of $\frac{1\frac{2}{3}}{4\frac{1}{4}}$ of $\frac{2}{3}$ of the vessel?

(*a*) $\frac{4}{17}$ of $\frac{2}{3}$ of $\frac{4}{17} = \frac{3 \times 2 \times 4}{11 \times 9 \times 17} = \frac{8}{561}$

(*b*) $\frac{1\frac{2}{3}}{4\frac{1}{4}}$ of $\frac{2}{3} = \frac{\frac{10}{6}}{\frac{17}{4}}$ of $\frac{2}{3} = \frac{40 \times 2}{136 \times 5} = \frac{2}{17}$

∴ $\frac{8}{561} : \frac{2}{17} :: £\frac{400}{33} : ?$

$£\frac{400 \times 2 \times 561}{33 \times 17 \times 8} = £100.$ Ans.

4. If the fourpenny loaf weigh 3·35 lbs. when wheat is at 4·75s. a bushel, what ought to be paid for $47\frac{1}{2}$ lbs. of bread when wheat is at 13·4s. a bushel?

After reducing the decimals to vulgar fractions, the following is the statement:—

$3\frac{7}{20}$ lbs. : $47\frac{1}{2}$ lbs. } :: 4d. : ?
$4\frac{1}{5}$s. : 13$\frac{2}{5}$s. }

$\frac{4d. \times 95 \times 67 \times 4 \times 20}{2 \times 5 \times 19 \times 67} = 160d. = 13s.\ 4d.$ Ans.

Grammar.

MALES AND FEMALES.

1. 'Lie not; but let thy heart *be true* to God,
Thy mouth to it, thy actions *to them both*;
Cowards tell lies, and *those that fear* the rod,
The stormy working soul vents lies and froth.
Dare to be true, nothing can need a lie;
A fault which needs it most *grows two thereby*.'
GEORGE HERBERT.

Paraphrase this extract.

2. Parse the words printed in italics.

3. Analyse the last four lines.

1. Tell the truth; let your words give expression to the thoughts that are known to God, and let your deeds correspond with what you think and what you say. Lying is unknown to brave men; it is a quality only of those who fear punishment. Blustering and boasting spirits alone give mouth to false vaunting and high-sounding phrases. Have the courage to speak the truth; it is better to own faults than increase them by shielding one's self with a lie. There is no excuse for using deceit.

PARSING.

Be—intrans. irreg. verb, *am, was, been*, infin. pres. indef., gov. by 'let.'
true—predic. adj., qual. 'heart.'
to—prep., showing relation between 'true' and 'them.'
them—demonst. pron., 3rd pers., plur., referring to 'heart' and 'mouth,' obj., gov. by 'to.'
both—predic. adj., qual. 'them.'
those—demonst. adj. pron., mas. or fem., plur., nom., subj. of (*tell*).
that—simple rel. pron., mas. or fem., plur., referring to 'those,' nom., subj. of 'fear.'
fear—reg. trans. verb, indic., pres. indef., 3rd pers., plur., agr. with 'that.'
grows—irreg. intrans. verb, *grow, grew, grown*, indic pres. indef., 3rd pers., sing., agr. with 'fault.'
two—numeral adj., qual. (faults) nom. after 'grows.'
thereby—adv., mod. 'grows.'

ANALYSIS.

Sentence.	Kind.	Subj.	Predicate	Object.	Extension.	Connective.
(1) Cowards tell lies	Principal	Cowards	tell	lies	...	...
(2) and those (tell lies)	Principal.	those	(tell)	(lies)	...	and
(3) that fear the rod	Subord. adj. to (2)	that	fear	the rod	...	that
(4) The stormy working soul vents lies and froth	Principal.	the stormy working soul	vents	lies and froth	...	...
(5) Dare to be true	Principal.	(you)	dare	to be true (*completion*)	...	...
(6) Nothing can need a lie	Principal.	Nothing	can need	a lie	...	...
(7) A fault grows two thereby	Principal.	a fault	grows	two (*completion*)	thereby (*manner*)	...
(8) which needs it most.	Subord. adj. to (7)	which	needs	it	most (*degree*)	whic

4. Correct, if needful, these sentences, and give your reasons for altering them:—

'Let thou and I the battle try.'
'There let him lay.'
'My banks they are furnished with bees.'
'This England never did, nor never shall
Lie at the proud foot of a conqueror.'

'Let *thee* and *me* the battle try.'—Transitive verbs govern the objective case.

'There let him *lie*.'—*Lay* is transitive, and the meaning requires it intransive.

'My banks are furnished with bees.'—Unless when very particular emphasis is necessary, a noun and its pronoun should not be used as the nominative to the same verb. Poets use both frequently.

'This England never did, and never shall
Lie at the proud foot of a conqueror.'—Two negatives coming together in English make an affirmation. The meaning here requires a negative.

5. Make a list of noun terminations, by which you may know that certain words are Latin and not English in their origin. Give three examples of each formation.

LATIN TERMINATIONS.	EXAMPLES.
—or	inspector, confessor, doctor.
—ent	respondent, superintendent, agent.
—ary	lapidary, plenipotentiary, aviary.
—ant	descendant, occupant, pendant.
—ate	advocate, confederate, estimate.
—acy	accuracy, celibacy, privacy.
—ance—ancy	fragrance, constancy, variance.
—ion	creation, union, tension.
—tude	multitude, gratitude, magnitude.
—ure	rapture, conjecture, scripture.

Geography.

(*Answer either Q. 2 or Q. 3; not both, unless you do the map in Q. 2.*)

1. Draw a full map, showing Burmah, Siam, and the islands of the Indian Archipelago.
N.B.—Insert the lines of latitude and longitude.

2. What are the *tropics?* What parts of Asia and Africa lie between the tropics? Explain, *as to children*, why these countries have so hot a climate.

If you like, instead of the map in Q. 1, you may draw a sketch-map in illustration of this answer.

At a point 23½° north of the equator (at the tropic of Cancer), the vertical sun appears to stop when it is mid-summer with us. As it moves southward our summer wanes; it crosses the equator and appears to travel on until it has reached 23½° on the other side of the line (the tropic of Capricorn); then six months have passed—it is mid-winter with us and mid-summer with the people in the southern hemisphere. The sun turns back (the word *tropic* meaning the place of turning), retraces its course over the equator, and at the expiration of a twelvemonth is at our tropic (Cancer) again, bringing us summer.

In Asia the southern halves of Arabia and Hindostan, nearly the whole of Further India with a small part of China, and the whole of the East India Islands lie within the tropics. The whole of Africa, with the exception of Morocco, Algeria, Tunis, Tripoli, Egypt, the northern third of the Sahara, Cape Colony, Natal, the Transvaal and Namaqua Land, lies within the tropics.

The reason that it is hotter in those parts of the world arises from the fact of its being within the Torrid Zone, where the sun is vertical at noon over every place two days in the year. The more nearly the sun approaches the zenith of an observer the more powerful is the heat.

3. Explain, *as to children*, the nature of land and sea breezes.

LAND AND SEA BREEZES.

DEFINITION.—Land breezes blow from the land to the sea. Sea breezes blow from the sea towards the land. (*Illustrate from the draught of air from the room up the chimney, also from the currents of colder air from the outside into the room under the door; and that of the warmer air over the door.*)

CAUSE.—If the sun shines on two tracts of surface, the one water and the other solid land, the latter becomes more rapidly heated than the former, and at the end of the day will be found much warmer than the water. On the other hand, in the absence of the sun the land cools faster than the water, and at the end of the night it will be found below the temperature of the adjoining water. When the land is hottest, the air resting upon it will be hotter and lighter than the air over the sea, and the cold air from the sea will rush in upon the hot. (*Compare these effects with the hot air in the room (or over the fire), going through the chink at the top of the door (or up the flue), and the cold current coming in under the door and towards the fire.*) Thus during the day there will be a breeze from the sea to the land, and during the night a breeze from the land to the sea. These sea and land breezes are felt regularly on all sea-coasts when the other winds are not too strong.

Needlework.

Two hours and a half allowed.

FEMALES.

(The needlework specimens will be collected by the Inspector at the expiration of one hour after the distribution of the examination papers.)

SECOND PAPER.

Two hours and a half allowed.

Arithmetic.

MALES.

1. If a man sells £4,000 stock from the 3 per cents. at par, and with the proceeds buys 6 per cent. railway debentures at 160; what is the difference in his income? (Omit brokerage.)

Income from 2nd investment $= \frac{£4000 \times 6}{160} = £150$

" " 1st " $= \frac{£4000 \times 3}{100} = £120$

Increase of income = £30. Ans.

2. Find the compound interest on £750 for 3½ years at 4 per cent. per annum.

	£
For 1st yr. £4 gives $\frac{1}{25}$ of princ.	750
	30
" 2nd " " " $\frac{1}{25}$ "	780
	31·2
" 3rd " " " $\frac{1}{25}$ "	811·2
	32·448
" ½ yr. " " $\frac{1}{50}$ "	843·648
	16·87296
	860·52096
	750
	110·52096
	20
	10·4192 s.
	12
	5·0304

Compound int. = £110 10s. $5\frac{1}{25}$d. Ans.

3. Find the square roots of 361·732 and $37\frac{1}{144}$, the former to 4 decimal places.

(*a*)

```
361·732 (19.0192.  Ans.
1
29 | 261
   | 261
3801 | 7320
     | 3801
38029 | 351900
      | 342261
380382 | 962900
       | 760764
```

(*b*)

$$37\tfrac{1}{144} = \frac{37 \times 144 + 1}{144} = \frac{5329}{144}$$

(*c*)

$$\sqrt{\frac{5329}{144}} = \frac{73}{12} = 6\tfrac{1}{12}. \text{ Ans.}$$

4. A dealer by selling 72 sheep for £153 18s. lost 5 per cent.; what would he have gained per cent. and per sheep if he had sold them for £178 4s.?

(*a*)

£153 18s. or 3078 s. : £178 4s. or 3564 s. :: 95 : Hundredths of price.

$$\frac{95 \times 3564}{3078} = \frac{95 \times 396}{342} = \frac{95 \times 22}{19} = 110$$

Now 110 hundredths give a gain of 10 p. c. Ans.

(*b*)

	£	s.	d.
$\frac{£178\ 4s.}{72}$ =	2	9	6
$\frac{£153\ 18s.}{72}$ =	2	2	9
Gain per sheep =	0	6	9. Ans.

History.

MALES AND FEMALES.

1. What was the Commonwealth? How did it begin and end?

Soon after the execution of Charles I., the members of the 'Rump' Parliament voted the abolition of the monarchy and of the House of Lords. The new constitution was in outward form a republic, or, as they called it, 'a Commonwealth and Free State' under the supreme authority of the representatives of the people in Parliament. The practical business of Government was placed in the hands of forty-one members selected from the House of Commons, and called a Council of State. Some voices declared that the new Government was no better than the old, and in the army these mal-contents—called 'Levellers'—broke out into a mutiny which was swiftly crushed by Cromwell. Scotland and Ireland were in favour of a monarchy under Prince Charles, but Cromwell soon reduced these to obedience, and decisively defeated Charles at Worcester, 1651.

After the dissolution of Parliament by Cromwell, 1654, his Protectorate became a tyranny, but with more public aims than that of Charles I. Cromwell's third Parliament offered to make him king, but he refused to accept the crown. A few months afterwards Cromwell died and was succeeded in the Protectorate by his son Richard, who was so helpless that he had to resign. Anarchy now threatened the nation, when General Monk marched to London, and secured the calling of a free Parliament, which recalled King Charles II., 1660.

2. Who was the wife of George II.? Describe her character and political influence.

The wife of George II. was Caroline of Anspach. She was a very bright, clever, good-tempered woman. She governed her husband without letting him know of it, and she was guided by the great minister Sir Robert Walpole, whose constant policy was to keep England at peace, and himself in power. Between the Queen and the minister the reign was one of peace and prosperity.

3. In what wars has this country been engaged since 1850? Mention briefly their results.

The *Crimean War*, 1854-56, resulted in the defeat of the Russians; the strong fortress of Sebastopol being taken by the combined French and English armies, after a long and severe struggle. Peace was made by the Treaty of Paris, 1856.

In the year 1857, a mutiny broke out among the native troops of India, and spread over the whole country. It was put down by Sir Colin Campbell, 1858, and the result of the whole contest was that the Government of India was transferred from the East India Company to the hands of the Queen of England.

The Abyssinian war, 1867-8, was conducted by Sir Robert Napier (Lord Napier of Magdala), to free some British, imprisoned by King Theodore. The Abyssinians retired on the approach of the English troops, and the prisoners were sent into the British Camp. The loss of the British in the war was only twenty wounded, of whom two died. King Theodore committed suicide.

In 1874 the Ashantees interfered with the commerce of tribes under British protection, but Sir Garnet Wolseley compelled the king to accept terms of peace, after the destruction of his capital, Coomassie.

In 1878 a war began with the Afghans, and, after various events, was finished in 1880 by Sir Fred. Roberts, who placed a king favourable to the British on the throne.

The Zulu war, 1878-79, was ended by the complete defeat of Cetewayo at Ulundi; Cetewayo was captured and imprisoned.

In 1882 a massacre of Europeans at Alexandria and other causes led to the Egyptian war, in which the rebel Arabi was defeated at Tel-el-Kebir. Arabi was captured and afterwards banished to Ceylon.

Events are occurring in Egypt at this present moment (February, 1884), which may lead to the active intervention of a British force.

Teaching.

Sketch out the notes of a lesson suited for a junior class, on *the divisions of time.*

OBJECTS TO BE SEEN:—*Terrestrial Globe—Clock—Watch—Hour-glass—Sun-dial*—or *pictures of these.*

Introduce subject by questioning the class about what time is given for work—what for rest—eliciting *day* and *night*—show that the common time-keeper is the *sun*—but not exact enough. What contrivances have been made for showing divisions of time? Show hour-glass, or common three-minute glass in use—refer to sun-dial and explain the principle of it—show the use of a clock, and that it is necessary to have a striking apparatus attached, to warn us of the flight of time—show how deceiving it is to guess the time. Revolution of earth in 24 hours—making a day—day = 24 hours from midnight to midnight—hour = 60 minutes—minute = 60 seconds. Seven revolutions a week—365 a year = earth's journey round the sun. (Cause the globe to revolve in their presence.) Explain month by reference to the moon—ask meanings of morning—forenoon—noon—explain a.m. by the sun coming to the meridian—afternoon—p.m.—evening—night—ask for names of days of the week—months of the year—seasons—and quarterly terms.

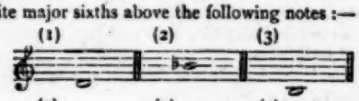
Note.—Names to be written on B.B., and spelt and pronounced by the class.

Music.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

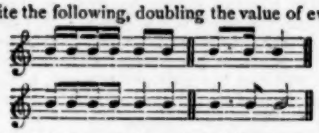
1. Write major sixths above the following notes:—



1.

2. Re-write the following, doubling the value of every note:—

2.



3. State (briefly) the meanings of the following:—(1) M. 100; (2) *Dal Segno*; (3) *Staccato.*

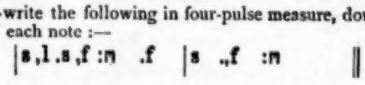
3. (1) "M. 100" means that the pendulum of the Metronome is to make 100 vibrations per minute; (2) *Dal Segno* means repeat from the sign 𝄋; (3) *Staccato* means that each note is to be sung or played separately and distinctly.

TONIC SOL-FA NOTATION.

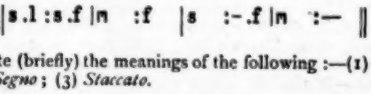
1. Write major sixths above the following notes:—(1) *ray*; (2) *ta*; (3) te_1.

1. (1) *Ray* to *te*; (2) *ta* to soh^1; (3) te_1 to *se*.

2. Re-write the following in four-pulse measure, doubling the value of each note:—



2.



3. State (briefly) the meanings of the following:—(1) M. 100; (2) *Dal Segno*; (3) *Staccato.*

3. (1) "M. 100" means that the pulses of the tune are to move at the rate of 100 in the minute; (2) repeat from the sign 𝄋; (3) each note is to be played or sung separately and distinctly.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after,* **1st May, 1878; and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including Question 3, *if you can.*

1. If there be two straight lines, one of which is divided into any number of parts, the rectangle contained by the two straight lines is equal to the rectangles contained by the undivided line, and the several parts of the divided line.

Prop. 1, Bk. II.

2. If a straight line be divided into two equal, and also into two unequal parts, the squares on the two unequal parts are together double of the square on half the line and of the square on the line between the points of section.

Prop. 9, Bk. II.

3. Divide a given straight line into two parts such that the sum of their squares may be the least possible.

If a straight line be bisected, *the sum of the squares on the two halves is the least possible;* for if the line be cut in any other point the line will be cut unequally, and by Prop. 9, Bk. II., the sum of the squares on the two unequal parts is double of the square on half the line and of the square on the line between the points of section; or, in other words, the sum of the squares on the parts of a line cut unequally is always greater than the sum of the squares on the halves of the line by double the square on the part between the middle of the line and the other point.

Algebra.

Answer two Questions.

1. Simplify $\frac{(a^2+b^2)^2}{ab(a-b)^2}-\frac{a}{b}-\frac{b}{a}-2$.

$$\frac{(a^2+b^2)^2}{ab(a-b)^2}-\frac{a}{b}-\frac{b}{a}-2$$
$$=\frac{(a^2+b^2)^2}{ab(a-b)^2}-\frac{a^2-b^2-2ab}{ab}$$
$$=\frac{(a^2+b^2)^2-(a+b)^2(a-b)^2}{ab(a-b)^2}$$
$$=\frac{(a^2+b^2)^2-(a^2-b^2)^2}{ab(a-b)^2}$$
$$=\frac{4a^2b^2}{ab(a-b)^2}=\underline{\frac{4ab}{(a-b)^2}}. \text{ Ans.}$$

2. Solve the equations :—

$$(1)\quad \begin{cases} \frac{3x}{10}-\frac{y}{15}-\frac{4}{9}=\frac{x}{12}-\frac{y}{18} \\ 2x-\frac{8}{3}=\frac{x}{12}-\frac{y}{15}+\frac{11}{10} \end{cases}$$

$$(1)\ (a)\ \frac{3x}{10}-\frac{y}{15}-\frac{4}{9}=\frac{x}{12}-\frac{y}{18}$$
$$54x-12y-80=15x-10y$$
$$39x-2y=80$$

$$(b)\quad 2x-\frac{8}{3}=\frac{x}{12}-\frac{y}{15}+\frac{11}{10}$$
$$120x-160=5x-4y+66$$
$$115x+4y=226$$
From (a) $$78x-4y=160$$
$$193x=386$$
$$x=\underline{2}. \text{ Ans.}$$

Hence $y=\underline{1}$. Ans.

$$(2)\ 780x^2-73x+1=0$$
$$780x^2-73x=-1$$
$$x^2-\tfrac{73}{780}x=-\tfrac{1}{780}$$
$$x^2-\tfrac{73}{780}x+(\tfrac{73}{1560})^2=(\tfrac{73}{1560})^2-\tfrac{1}{780}=\frac{5329-3120}{(1560)^2}$$
$$x^2-\tfrac{73}{780}x+(\tfrac{73}{1560})^2=\frac{2209}{(1560)^2}$$
$$x-\tfrac{73}{1560}=\pm\tfrac{47}{1560}$$
$$x=\tfrac{73}{1560}\pm\tfrac{47}{1560}$$
$$=\tfrac{120}{1560} \text{ or } \tfrac{26}{1560}=\underline{\tfrac{1}{13}} \text{ or } \underline{\tfrac{1}{60}}. \text{ Ans.}$$

3. A pound of tea and three pounds of sugar cost six shillings, but if sugar were to rise 50 per cent. and tea 10 per cent. they would cost seven shillings. Find the price of tea and sugar.

Let x = price of 1 lb. tea and y = price of sugar,
then $x+3y=6$s., or $11x+33y=66$s.,
and $\frac{11}{10}x+\frac{33}{2}y=7$s., or $11x+45y=70$s.
$$12y=4\text{s.}$$
Sugar = $y=\underline{4}$d. Ans.

$\therefore$ Tea = $x=\underline{5}$s. Ans.

Mensuration.

A square of very thin gold whose side is 196 inches is divided into squares (like a chess board) each of whose sides is 14 inches, and circles incribed in these squares are punched out of them. If the price of gold leaf is £2 14s. per sq. yd., find the value of the remainder of the large square after the circles have been removed.

Area of square $=196\times196$ $=38416$ sq. in.
,, circles $=14^2\times\cdot7854\times196=30171\cdot9264$ sq. in.
area to be gilt $=8244\cdot0736$ sq. in.
area ,, in sq. yds. $=6\cdot3612$ nearly
6·3612 sq. yd. at £2 14s. per yd. $=£17\cdot17524$
$=\underline{£17\ 3\text{s. } 6\text{d.}}$ nearly.

Arithmetic.

FEMALES.

1. At what rate per cent. will £325 16s. 8d. amount to £374 6s. $0\frac{1}{4}$d. in $3\frac{1}{2}$ years at simple interest?

Interest = £374 6s. $0\frac{1}{4}$d − £325 16s. 8d. = £48 9s. $4\frac{1}{4}$d.

$3\frac{1}{2}$ yrs. : 1 yr.
$325\frac{1}{6}$: 100
} :: £48 9s. $4\frac{1}{4}$d. : ?

$$\frac{£48\ 9\text{s. } 4\tfrac{1}{4}\text{d.}\times1\times100}{3\tfrac{1}{2}\times325\tfrac{1}{6}}=\frac{4652900 \text{ far.}\times100\times2\times6}{7\times1955}$$
$$=\frac{5582280000}{1370935} \text{ far.}$$
$$=4080 \text{ far.}=\underline{£4\tfrac{1}{4}}. \text{ Ans.}$$

2. A school contains 380 scholars, 5 per cent. are between the ages of 12 and 14; 10 per cent. between 10 and 12; 35 per cent. between 8 and 10, and the remainder under that age; find the number of each class.

5 p. c. of 380 = $\frac{1}{20}$ of 380 = 19 between 12 and 14. Ans.
10 p. c. of 380 = $\frac{1}{10}$ of 380 = 38 between 10 and 12. Ans.
35 p. c. of 380 = $\frac{7}{20}$ of 380 = 133 between 8 and 10. Ans.
$\therefore$ Remaining 50 p. c. or $\frac{1}{2}$ = 190 under 8. Ans.

3. Find the quantity of stock purchased by investing £504 in the 4 per cents. at 96; and the yearly income.

(a) 96 : 100 :: £504 : Quantity of stock.
$$\frac{£504\times100}{96}=\underline{£525}. \text{ Ans.}$$

(b) $$\frac{£525\times4}{100}=\underline{£21} \text{ of income. Ans.}$$

4. If a tradesman gains 5s. 6d. on an article which he sells for 22s., what is his gain per cent.?

Here 5s. 6d. is gained on 16s. 6d.
$\therefore$ $16\frac{1}{2}$s. : $5\frac{1}{2}$s. :: 100 : Gain p. c.
$$\frac{100\times5\frac{1}{2}}{16\frac{1}{2}}=\frac{1100}{33}=\underline{33\tfrac{1}{3}}. \text{ Ans.}$$

Grammar.

MALES AND FEMALES.

1. Analyse this sentence, and comment on the meaning and use of the words 'but' and 'his.'

'There's not the smallest orb which thou beholdest
But in *his* motion like an angel sings.'

ANALYSIS.

SENTENCE.	Kind.	Subject.	Predicate.	Object.	Extension	Connective.
(1) There's not the smallest orb	Principal	the smallest	is not (= exists not)		*there (merely introductory)*	
(2) which thou beholdest	Subord. adj. to (1)	thou	beholdest	which		which
(3) But in his motion like an angel sings.	Subord. adj. to (1)	But = which not	sings		in his motion (*cause*) like an angel (*manner*)	but

'*But*' as here used is equivalent to 'which not' or 'that not,' and for a negative restriction is a very emphatic form.

'*His*' is the genitive of *it* as used in the Bible and Shakespeare. 'Its' is not found in the former, and rarely in the latter.

2. What is the root, and what is the exact meaning of each of these words :—Importation, Coeval, Submarine, Inaudible?

Give in each case, three other English words derived from the same root?

WORD.	ROOT.	MEANING.	EXAMPLES.
Importation	portare	a carrying in	export, report, comport
Coeval	ævum	living at the same time	primeval, eternal, age
Submarine	mare	under the sea	transmarine, maritime, ultramarine
Inaudible	audire	not able to be heard	audience, audit, auditor.

3. Name any English words which relate either to law or military affairs, and which are of Norman-French origin.

Law terms:—Assize, attorney, chancellor, court fee, felony, parliament, plaintiff.

Military terms:—Arms, assault, battle, chivalry, tournament, lance, mail, hauberk.

4. Paraphrase the following passage, and point out what images or metaphors are contained in it:—

'How gloriously her gallant course she goes!
Her white wings flying,—never from her foes;
She walks the waters like a thing of life
And seems to dare the elements to strife.
Who would not brave the battle fire, the wreck,
To move the monarch of her peopled deck?'—BYRON.

What a grand spectacle is a ship speeding along in full sail! Her sails, spread out like wings, make her scud along; but they are not spread to carry her away from her enemies. She cuts the waters as if she was a living creature, anxious to try her strength with the storm. Any man would be proud to face the hurricane of shot or tempest only to command a crew in such a gallant ship.

FIGURES OF SPEECH.

We have an example of *apostrophe* in 'How gloriously her gallant course she goes'; of *metaphor*, in 'her white wings flying;' of *personification*, in 'she walks'; of *simile*, in 'like a thing of life and seems, etc., to strife'; of *interrogation*, in 'who etc., deck'; of *metaphor*, in 'the monarch'; and of *metonymy*, in 'her peopled deck.'

Geography.

(*Answer either Q. 2 or Q. 3, not both.*)

1. Give notes of a lesson on The Rocky Mountains; describing their position, general character, wild animals, the rivers that rise in them, and any railway that crosses them. Illustrate by a map, and insert the lines of latitude and longitude.

N.B.—*Keep in mind that the object of 'Notes' is to show how you would make each point clear and interesting to children. Introduce any anecdotes that would enliven the lesson.*

THE ROCKY MOUNTAINS.

POSITION AND GENERAL CHARACTER.—These mountains form the backbone of N. America, stretching from north to south. They are very lofty, wild, and rugged, the highest summit being Mt. Hooker, in Canada, 16,000 feet (compare with Ben Nevis or Snowdon), lower slopes densely wooded, higher up grassy slopes, variegated with bright-coloured flowers; summits are masses of rock clad with eternal snow. They extend from the Arctic Ocean S. through Canada and U. States. The tablelands immediately east of the Rocky Mts. are generally barren, but further east there are wide prairies, covered with long grass (*describe settler's team of bullocks crossing prairie*).

WILD ANIMALS.—The principal wild animals are the bison or buffalo, frequenting the plains at the foot of the Mts. (*give an account of a buffalo-hunt*), moose-deer, caribou or reindeer, elk, bear, wolf, spotted tiger, American panther, and argali.

RIVERS.—The only important river of Canada west of the Mts. is the Fraser, with a winding course among the hills and tablelands of British Columbia. The scenery on it is very grand. The Saskatchewan flows east to L. Winnipeg. In the United States the Colorado crosses the broad tableland between the Rocky Mts. and the Sierra Nevada, and flows into the Gulf of California. The Columbia further north flows into the Pacific. The Missouri forms with the Mississippi one of the greatest rivers in the world. The former is navigable for 1500 miles above the junction, and the junction is 800 miles from the sea. Large steamers, many of them with three decks, are constantly plying up and down the river.

RAILWAYS.—Two Pacific railways cross the Rocky Mts., one in Canada, and the other in the States. The former is scarcely completed. The latter has been in operation for some time, crossing the Continent from New York, past Omaha and Ogden, to San Francisco.

2. What are the *tropics*? What parts of the world lie between them? What is the effect of this situation on their climate. And why?

On the terrestrial globe we find what are termed parallels of latitude and meridians of longitude at every 10° or 15°. Besides these, at 23½° on either side of the equator are the tropics; the north one is the tropic of Cancer, the southern one is the tropic of Capricorn. Between these tropics is the torrid zone, which is the hottest part of the earth, from the reason that the sun is vertical over every place within it two days in the year. The more nearly the sun approaches the zenith of a place the more powerful is the heat.

The parts of the world lying in the torrid zone are the southern halves of Arabia and India, nearly the whole of Further India, with a small part of China, the whole of the East India Islands; the whole of Africa (except the states bordering on the Mediterranean, the northern third of the Sahara, Cape Colony, Natal, the Transvaal, and Namaqua Land), the greater part of Madagascar; the third part of Australia; Central America, with the most of the West India Islands, and more than the half of S. America.

3. What reasons can you give for believing that the earth and the other planets move round the sun?

Perhaps the most satisfactory reason for believing that the earth moves round the sun is the simple way in which the movement accounts for the seasons and all the appearances in the motions of the other heavenly bodies. The apparent motions of the planets among the stars are much more irregular than those of the sun and moon; but the theory of their revolution round the sun in conjunction with that of the earth, affords a simple explanation of all their irregularities.

Needlework.

Two hours and a half allowed.

FEMALES.

The needlework specimens will be collected by the Inspector at the expiration of one hour after the distribution of the examination papers.

SECOND PAPER.

Arithmetic.

Two hours and a half allowed.

MALES.

1. If a bank pays 12½ per cent. dividend, what interest should I get by purchasing £5 shares for £12 5s.?

£12½ : £5 :: £12½ : Interest required.

$$\frac{£12\tfrac{1}{2} \times 5}{12\tfrac{1}{2}} = \frac{50 \times 5}{49} = 5\tfrac{5}{49} \text{ p. c.} \quad \text{Ans.}$$

2. If the present value of a bill due 9 months hence, interest being at 4½ per cent., be £1700, what is the amount of the bill?

Interest on £100 for 9 mos. at 4½ = 3½
Amount of " " " = 103½
∴ 100 : 1700 :: 103½ : Amount required.

$$\frac{£827 \times 1700}{8 + 100} = £1757\tfrac{1}{8} = £1757\ 7s.\ 6d. \quad \text{Ans.}$$

3. If a man has £3600 railway stock paying 4½ per cent., how much would he gain annually if he sold out at 124½ and invested the proceeds in 6 per cent. debentures at 143⅛, brokerage being charged on each transaction?

(*a*) £3600 brings 124½ per 100 = £4491
∴ £144 : £4491 :: £6 : 2nd income.

$$\frac{£6 \times 4491}{144} = £187\ 2\ 6 \text{ 2nd income}$$

(*b*) £3600 at 4½ p. c. = 162 0 0 1st "
Annual gain = 25 2 6 Ans.

4. In a train the number of 1st class to the number of 3rd class passengers was as 2 : 15, and the fare for 1st class to the fare for 3rd class as 7 : 3. How much did the whole of each class pay if the amount received was £29 10s.?

2 : 15 :: no. of 1st class : no. of 3rd class passengers.
7 : 3 :: fare of ,, : fare of ,, ,,
14 : 45 :: value of all 1st : value of all 3rd
∴ 59 : 14 :: £29 10s. : £7 for 1st class. Ans.
59 : 45 :: £29 10s. : £22 10s. 3rd do. Ans.

History.

MALES AND FEMALES.

1. At what period of our history has the chief power been with the Sovereign, the nobility, and the commonalty respectively? Where would you say it is now?

Under the Tudors, who came into possession of the Crown after the Wars of the Roses, there began a constitutional retrogression, in which the slow work of the previous age was rapidly undone. Parliamentary life was almost suspended or turned into a formality by the overpowering influence of the Crown. The legislative powers of the two Houses were usurped by the Royal Council. Arbitrary taxation reappeared in benevolences and forced loans. The freedom which had been won when the influence of the barons under De Montfort was all powerful, and its tradition had been watched over by the Church, but with the battle of Towton feudalism was swept away, and the baronage lay a mere wreck, after the storm of the Civil War. The new monarchy, which came in with the Tudors, was completely demolished by the Long Parliament of 1640, when the commonalty got the upper-hand and kept it, more or less, till a constitutional Government of King, Lords, and Commons, took its sway. It is not far wrong to say that the chief power now lies in the Commons.

2. 'Sir R. Walpole's financial scheme was to change customs into excise duties, and to make London a free port for the whole of Europe.' Explain this 'scheme' and the grounds of opposition to it.

Customs are duties levied on foreign productions when landed on British shores; excise is a tax levied on articles manufactured in Britain. To check smuggling, which was very openly carried on at the time, Walpole proposed to bring wine and tobacco under the excise. By the increase of trade, and of money thus levied, the land-tax, he said, might be abolished in course of time. The total abolition of the land-tax was meant to satisfy the county gentlemen, and the bonding or warehousing of wine was an immense advantage to the merchant. Yet the vehemence of ignorant opposition was not softened. One declared that in all countries excises of every kind were looked upon as badges of slavery; merchants declared that they would be ruined, and the Opposition took up the same cry, imagining that they saw a whole army of excisemen ready at any time to vote as Walpole desired.

3. 'The battles of Austerlitz and Trafalgar were nearly contemporaneous;' contrast them and their consequences.

In 1805 Nelson met *the combined French and Spanish fleets* off Cape Trafalgar. Here this great sailor, though at the cost of his own life, attacked and defeated them, and thus *completely destroyed the power of the French at sea.* . . . But if Napoleon lost this great naval action he gained a victory on land two months after which more than made up for the loss. At Austerlitz, in Moravia, this untiring general fell upon *the combined Austrian and Russian armies*, and defeated them with immense slaughter. The victory of Austerlitz, which *marks the highest point in Napoleon's career*, broke Pitt's heart. 'Roll up that map,' he said pointing to the map of Europe; 'it will not be wanted for ten years.' Sad and dejected he died in a few weeks, and it so happened that Nelson and Pitt—two of the greatest men England ever produced—were carried to the grave in the same month.

Teaching.

Write out notes of a lesson on *The Arctic Regions.*

POSITION AND EXTENT.—A circle round the earth at 1600 miles from the North Pole as a centre is called the Arctic Circle (*arktos*, a bear, the north)—all the land and sea within this circle forms the Arctic regions or North Frigid Zone—covers a space larger than the whole of Europe—extends through the North of Europe, Asia, and America round the globe. (*Refer to map, or better, to the globe.*)

CHARACTER.—Not a tree can be found in it; even the hardiest plants are stunted in growth and become creepers. In the middle of these regions the sun is one half of the year above the horizon and the other half below it—one long dreary night of six months—gloom often relieved by the magnificent spectacle of the Aurora Borealis—this shines with a brilliancy unknown elsewhere. (*Give or read a description of this.*)

ARCTIC OCEAN.—This is studded with islands—most of them lying along coast of America—largest is Greenland (*describe*)—for three centuries navigators tried to discover a *north-west passage* to the Pacific (*show on globe or map*)—most notable attempt that by Sir John Franklin, who was successful but lost his life (*reference to late attempts to reach the Pole and to the north-east passage*).

PARTS OF ARCTIC REGIONS.—In *Europe* north part of Norway is within Arctic Circle—climate milder owing to warm water of the Atlantic—Lapland and small part Russia also within the Circle. In *Asia* the north, where three mighty rivers—Obi, Lena, Yenesei—enter the sea, becoming more and more clogged with ice as they near it, and they overflow their banks, making this part of Asia a dismal swamp without pasture. In *America* the Arctic portion is covered with snow and ice nearly the whole of the year—in winter an awful silence reigns—scarcely a living creature—when summer ends the flocks of birds that made their appearance in the spring to feed along the coasts return to the south, darkening the air with their numbers.

ANIMALS.—Whale, walrus, seal, in the sea; Polar bear, Arctic fox, reindeer, on land.

INHABITANTS.—Laps in Lapland; Esquimaux in Arctic America; Samoiedes in Arctic Russia.

Music.

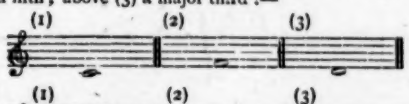
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both.* The questions in the Tonic Sol-fa Notation will be found at the end.)

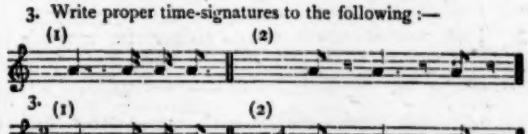
1. Write in the treble clef the signature and the ascending scale of F minor, using the minor or flat sixth and the major or sharp seventh.

1.

2. Write above (1) an augmented second; above (2) an augmented fifth; above (3) a major third :—



3. Write proper time-signatures to the following :—



TONIC SOL-FA NOTATION.

1. Write (1) above *doh* an augmented second; (2) above *fah* an augmented fifth; (3) above *ray* a major third.

1. (1) *doh* to *re*; (2) *fah* to *de*; (3) *ray* to *fe*.

2. In the minor or *lah* mode (1) which is the essential or minor sixth; and (2) which is the essential or major seventh?

2. (1) *fah*; (2) *se*.

3. Write the following in six-pulse measure by trebling the value of every note :—

|s ,- ,l :s ,d ,- |m ,- ,r :d ‖

3. |s :-:l |s :d :-|m :-:r |d :-:-‖

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Arithmetic.

1. JEAN.—If a man for 4 days running spends each day $\frac{1}{3}$ of what he had at the beginning of the day, and then has 10s. left, how much had he at first? (*Bryant.*)

Part left after 1st day = $\frac{2}{3}$ of original amount;
" " 2nd " = $\frac{2}{3}$ of $\frac{2}{3}$ " " = $\frac{4}{9}$ " " ;
" " 3rd " = $\frac{2}{3}$ of $\frac{4}{9}$ " " = $\frac{8}{27}$ " " ;
" " 4th " = $\frac{2}{3}$ of $\frac{8}{27}$ " " = $\frac{16}{81}$ " " ;
$\frac{16}{81}$ of original amount = 10s.,
∴ Original amount = 10s. × $\frac{81}{16}$
= $\frac{405}{8}$s.
= £2 10s. 7½d. Ans.

Note.—We believe your writing would obtain 90 per cent. of marks. It is rather *too small.*

2. YOUNKER.—I buy wheat at 39s. a quarter, and some of a superior quality at 6s. a bushel; in what proportions must I mix them, so as to gain 25 per cent. by selling the mixture at 57s. 6d. per quarter? (*Hamblin Smith.*)

Cost price of mixture = 57s. 6d. × $\frac{100}{125}$
= 57s. 6d. × $\frac{4}{5}$
= 46s.;

Difference between cost price of mixture and 1st kind = 46s. − 39s.
= 7s.;
" " " " 2nd " = 48s. − 46s.
= 2s.;
∴ Quantity of 1st kind : Quantity of 2nd kind :: 2s. : 7s.
:: 2 : 7 Ans.

3. H. BULL.—The hour and minute hands of a watch are together at 12 o'clock; when will they next be together?

The minute hand moves twelve times as fast as the hour hand;
∴ The difference between the rates of the minute and hour hands is eleven times the rate of the hour hand.
∴ They will not be together between 12 and 1. The minute hand must gain 5 minutes on the hour hand to be together between 1 and 2;
∴ Distance gone by hour hand = 5 min. ÷ 11
= $\frac{5}{11}$ min.;
∴ The hands will next be together at 5$\frac{5}{11}$ min. past 1. Ans.

4. W. T. NORTON.—A and B can do a piece of work in 10 days, B and C in 15 days, and A and C in 25 days; they all work at it for 4 days, A then leaves, and B and C go on for 5 days, B then leaves. In how many days will C finish the work? (*Barnard Smith.*)

A and B can do the work in 10 days,
B and C " " 15 " ,
A and C " " 25 " ;
∴ A and B can do in 1 day $\frac{1}{10}$ of the work,
B and C " " " $\frac{1}{15}$ " ,
A and C " " " $\frac{1}{25}$ " ;
∴ 2(A, B, and C) can do in 1 day ($\frac{1}{10}+\frac{1}{15}+\frac{1}{25}$) of the work
= $\frac{15+10+6}{150}$ " "
= $\frac{31}{150}$ " "
∴ A, B, and C can do in 1 day ($\frac{31}{150}\div 2$) " "
= $\frac{31}{300}$ " "
∴ C can do in " ($\frac{31}{300}-\frac{1}{10}$) " "
= $\frac{31-30}{300}$ " "
= $\frac{1}{300}$ " "
Part don by all in 4 days = $\frac{31}{300}\times 4$
= $\frac{31}{75}$;
Part done by B and C in 5 days = $\frac{1}{15}\times 5$
= $\frac{1}{3}$;
∴ Part remaining to be done = $1-(\frac{31}{75}+\frac{1}{3})$
= $1-\frac{31+25}{75}$
= $1-\frac{56}{75}$
= $\frac{19}{75}$;
∴ C can finish the work in ($\frac{19}{75}\div\frac{1}{300}$) days
= ($\frac{19}{75}\times 300$) days
= 76 days. Ans.

5. BILL AND WILLIE.—A boy playing at marbles lost in the first hour all he had, and got into debt for half a dozen more; in the second hour he gained double of all that he had lost in the first, and 40 per cent. besides of the number he started with, which, after he had paid his debt, increased his total store of marbles at the end of his play by 48; what number had he to start with? (*Pupil Teachers' Exam.*, July, 1877.)

Gain on the two hours' play = (100 + 40) per cent. of original number and 6 marbles more;
Marbles. Marbles. Marbles.
∴ 140 : 48 − 6 :: 100 : Original number of marbles.
Marbles.
42 : 42 :: 100 : Original number.
3
= 30 marbles. Ans.

6. DEVONIAN.—The sum of £760 is divided between A, B, C. The shares of A and B together exceed the share of C by £240, and the shares of B and C together exceed the share of A by £360. What is the share of each? (*Hamblin Smith*).

A's share + B's share = C's share + £240,
But, " + " = £760 − C's share;
∴ C's share + £240 = £760 − C's share,
Twice C's share = £760 − £240
= £520,
∴ C's share = £260.

B's share + C's share = A's share + £360,
But, " + " = £760 − A's share;
∴ A's share + £360 = £760 − A's share,
Twice A's share = £760 − £360
= £400,
∴ A's share = £200.
B's share = £760 − (£200 + £260)
= £760 − £460
= £300.

Note.—*John Stuart Mill's* 'Political Economy.'

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" " 2nd " = $\frac{3}{4}$ of $\frac{3}{4}$ " " = $\frac{9}{16}$ " ";
" " 3rd " = $\frac{3}{4}$ of $\frac{9}{16}$ " " = $\frac{27}{64}$ " ";
" " 4th " = $\frac{3}{4}$ of $\frac{27}{64}$ " " = $\frac{81}{256}$ " ";
$\frac{81}{256}$ of original amount = 10s.,
∴ Original amount = 10s. × $\frac{256}{81}$
= $\frac{2560}{81}$s.
= £2 10s. $7\frac{7}{81}$d. Ans.

Note.—We believe your writing would obtain 90 per cent. of marks. It is rather *too small*.

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B and C " " " $\frac{1}{15}$ " ,
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= $\frac{15+10+6}{150}$ " "
= $\frac{31}{150}$ " "
∴ A, B, and C can do in 1 day ($\frac{31}{150}\div 2$) " "
= $\frac{31}{300}$ " "
∴ C can do in " ($\frac{31}{300}-\frac{1}{10}$) " "
= $\frac{31-30}{300}$ " "
= $\frac{1}{300}$ " "
Part don by all in 4 days = $\frac{31}{300}\times 4$
= $\frac{31}{75}$;
Part done by B and C in 5 days = $\frac{1}{15}\times 5$
= $\frac{1}{3}$;
∴ Part remaining to be done = $1-(\frac{31}{75}+\frac{1}{3})$
= $1-\frac{31+25}{75}$
= $1-\frac{56}{75}$
= $\frac{19}{75}$;
∴ C can finish the work in ($\frac{19}{75}\div\frac{1}{300}$) days
= ($\frac{19}{75}\times 300$) days
= 76 days. Ans.

5. BILL AND WILLIE.—A boy playing at marbles lost in the first hour all he had, and got into debt for half a dozen more; in the second hour he gained double of all that he had lost in the first, and 40 per cent. besides of the number he started with, which, after he had paid his debt, increased his total store of marbles at the end of his play by 48; what number had he to start with? (*Pupil Teachers' Exam.*, July, 1877.)

Gain on the two hours' play = (100+40) per cent. of original number and 6 marbles more;
∴ 140 Marbles. : 48−6 Marbles. :: 100 Marbles. : Original number of marbles.
$\frac{140}{3}$: $\frac{42}{3}$ :: 100 : Original number.
= 30 marbles. Ans.

6. DEVONIAN.—The sum of £760 is divided between A, B, C. The shares of A and B together exceed the share of C by £240, and the shares of B and C together exceed the share of A by £360. What is the share of each? (*Hamblin Smith*).

A's share + B's share = C's share + £240,
But, " + " = £760 − C's share;
∴ C's share + £240 = £760 − C's share,
Twice C's share = £760 − £240
= £520,
∴ C's share = £260.

B's share + C's share = A's share + £360,
But, " + " = £760 − A's share;
∴ A's share + £360 = £760 − A's share,
Twice A's share = £760 − £360
= £400,
∴ A's share = £200.
B's share = £760 − (£200 + £260)
= £760 − £460
= £300.

Note.—*John Stuart Mill's* 'Political Economy.'

7. AXIOM.—Eleven cubic inches of iron weigh as much as seven cubic inches of lead, and the price per ton of lead is £15, of iron £4. The value of a certain block of lead is £36 17s. 11d.; what would be the value of a block of iron of the same size?

Cub. in. : Cub. in. :: £ : £
11 : 7 :: 36 17 11 : Value of block of iron.
£ : £
15 : 4

∴ Value of block of iron $= \frac{£36\ 17s.\ 11d. \times 7 \times 4}{11 \times 15}$
$= \frac{£1033\ 1s.\ 8d.}{165}$
$= £6\ 5s.\ 2\frac{2}{3}d.$ Ans.

8. SEMPER IDEM.—By selling apples at 3 for a penny, I gain 5 per cent.; what do I gain or lose per cent. by selling them at £1 per 1000? (*Pupil Teachers' Examination.*)

£ d. £
$\frac{105}{21} : \frac{1}{3} :: \frac{105}{20}$: Cost price of each apple;
$= \frac{4}{7}d.$
Cost price of 1000 apples $= (\frac{4}{7} \times 1000)d. = \frac{4000}{7}d.$
d. £ d. d.
∴ $\frac{4000}{7} : 100 :: (\frac{20000}{21} - 240)$: Loss per cent.
d. £ d.
$\frac{400}{7} : 1 :: \frac{3440}{21}$: Loss per cent.
∴ Loss per cent. $= \frac{3440}{400} = 8\frac{3}{5} = 24\frac{1}{5}$. Ans.

9. LIZZIE.—Bought a quantity of quills at 4s. 7d. a hundred, and sold them so as to gain $\frac{1}{5}$ of the selling price. What was the selling price, and what was the profit per cent. on the cost price? (*Moffatt's* 'Pupil Teachers' Course.')

Selling price = cost price + $\frac{1}{5}$ of selling price,
Selling price − $\frac{1}{5}$ of selling price = cost price,
$\frac{4}{5}$ selling price = cost price,
∴ Selling price = cost price × $\frac{5}{4}$
= 4s. 7d. × $\frac{5}{4}$
= (11 × 8)d.
= 7s. 4d. Ans.

s. d.
7 4
s. d. £ 4 7
∴ 4 7 : $\frac{105}{20}$ :: 2 9 : Gain per cent.
12 12
$\frac{55}{5}$ 33
3
$= £60.$
∴ Gain = 60 per cent.

10. PRÆCEPTOR.—If the ratio of threepenny to fourpenny pieces in a given sum, which consists entirely of those coins, were altered from 3 : 7 to 7 : 3, the sum would be diminished by £20. Find the sum. (*Scholarship*, 1883.)

Amount of 3 threepenny and 7 fourpenny pieces
= (3d. × 3) + (4d. × 7) = 9d. + 2s. 4d. = 3s. 1d.;
Amount of 7 threepenny and 3 fourpenny pieces
= (3d. × 7) + (4d. × 3) = 1s. 9d. + 1s. = 2s. 9d.;
Difference between these amounts = 3s. 1d. − 2s. 9d. = 4d.
d. £ s. d.
∴ 4 : $\frac{240}{5}$ :: 3 1 : Sum.
5 12
37
$= £185.$ Ans.

11. A. B. C.—A man having bought a lot of goods for £150 sells $\frac{1}{3}$ at a loss of 4 per cent.; by what increase per cent. must he raise that selling price, in order that, by selling the rest at the increased rate, he may gain 4 per cent. on the whole transaction?

Selling price of $\frac{1}{3}$ of goods = £50 − £2 = £48;
Gain on the whole transaction = £150 + £6 = £156;
∴ Remainder must be sold for £156 − £48 = £108;
Former selling price = £96 for goods costing £100;
∴ Difference = £108 − £96 = £12;
£ £ £
∴ $\frac{96}{4} : \frac{100}{25} :: 12$: Increase per cent.
25
2
$= 12\frac{1}{2}$ per cent. Ans.

12. JUMBO.—In billiards A can give B 5 in a game of 50, and C 10 points in 50; how many points can B give C in a game of 90?

A can give B 5 points in 50,
,, ,, C 10 ,, ,, ;
∴ B makes 45 points, while A makes 50,
C ,, 40 ,, ,, ,, ,, ;
∴ B can give C 5 points in 45,
,, ,, ,, 10 ,, 90.

13. ACME.—Simplify:—

$$\frac{2{\cdot}031746 \times 8{\cdot}818952380}{{\cdot}158730}.$$

$$\frac{2{\cdot}031746 \times 8{\cdot}818952380}{{\cdot}158730}$$

$$= \frac{2\frac{3}{63} \times 8{\cdot}818\frac{9}{11}}{\frac{10}{63}} = \frac{\frac{129}{63} \times 8\frac{(818 \times 21) + 20}{21000}}{\frac{10}{63}}$$

$$= \frac{\frac{129}{63} \times 8\frac{17220}{21000}}{\frac{10}{63}} = \frac{128}{63} \times \frac{92599}{10500} \times \frac{63}{10}$$

$$= \frac{11852672}{105000} = \frac{11852{\cdot}672}{105} = \frac{2370{\cdot}5344}{21} = \frac{790{\cdot}17813}{7}$$

$= 112{\cdot}88250\dot{4}761.$ Ans.

Note.—You have worked the other query correctly. The most expeditious way is to multiply the difference of the cubes of the diameters by ·5236.

Algebra.

1. BRYNAROOR.—Find the value of x in the following equation:—

$$(a+bx)(cx+d') = (a+b)(c+dx).$$

(*Atkin's* 'Mathematics.')

$$(a+bx)(cx+d) = (a+b)(c+dx)$$
$$acx + bcx^2 + ad + bdx = ac + bc + adx + bdx$$
$$bcx^2 + acx - adx = ac + bc - ad$$
$$x^2 + \frac{(ac-ad)x}{bc} = \frac{ac+bc-ad}{bc}$$
$$x^2 + \frac{(ac-ad)x}{bc} + \left(\frac{ac-ad}{2bc}\right)^2 = \frac{ac+bc-ad}{bc} + \frac{(ac-ad)^2}{4b^2c^2}$$
$$= \frac{(ac-ad)^2 + 4bc(ac+bc-ad)}{4b^2c^2}$$
$$= \frac{(ac-ad)^2 + 4bc(ac-ad) + 4b^2c^2}{4b^2c^2}$$
$$= \frac{(ac-ad+2bc)^2}{4b^2c^2}$$
$$x + \frac{ac-ad}{2bc} = \pm\frac{ac-ad+2bc}{2bc}$$
$$x = \pm\frac{ac-ad+2bc}{2bc} - \frac{ac-ad}{2bc}$$
$$= \frac{2bc}{2bc}, \text{ or } \frac{2ad-2ac-2bc}{2bc}$$
$\therefore\ x = 1$, or $\frac{ad-(a+b)c}{bc}$.

2. CORRESPONDENT.—Simplify the expression:—

$$3a - [b + \{2a - (b-c)\}] + \tfrac{1}{2} + \frac{2c^2 - \frac{1}{2}}{2c+1}.$$

(*Todhunter.*)

$$3a - [b + \{2a - (b-c)\}] + \tfrac{1}{2} + \frac{2c^2 - \frac{1}{2}}{2c+1}$$
$$= 3a - [b + 2a - b + c] + \tfrac{1}{2} + \frac{4c^2 - 1}{2(2c+1)}$$
$$= 3a - [2a + c] + \tfrac{1}{2} + \frac{2c-1}{2}$$
$$= 3a - 2a - c + \tfrac{1}{2} + c - \tfrac{1}{2}$$
$= a.$ Ans.

3. ENQUIRER.—Extract the square root of 25,400,544 in the scale of 6; transform 3,065·263 from the scale of 8 to the scale of 10; reduce $\frac{1}{18}$ from the scale of 10 to a duodecimal fraction. (*Lower Division*, May, 1883.)

$$\begin{array}{r|l} & 25'40'05'44(4,112 \\ & 24 \\ 121 & 140 \\ & 121 \\ 1221 & 1505 \\ & 1221 \\ 12222 & 24444 \\ & 24444 \end{array}$$

∴ Square root of 25,400,544 in the scale of 6 = 4,112.

$$\begin{array}{r|l} 10 & 3065 \text{ in the scale of } 8 \\ 10 & 236\ldots 9 \\ 10 & 17\ldots 8 \\ & 1\ldots 5 \end{array}$$

∴ 3,065 in the scale of 8 = 1,589 in the scale of 10.

·263 in the scale of $8 = \frac{2}{8} + \frac{6}{8^2} + \frac{3}{8^3}$

$= \frac{1}{4} + \frac{3}{64}$ in the common scale

$= \cdot 349609375$ in the scale of 10.

∴ 3,065·263 in the scale of 8

= 1,589·349609375 in the scale of 10.

$\frac{1}{12} \times 12 = \frac{1}{4}$,

$\frac{1}{4} \times 12 = 3$;

∴ $\frac{1}{12}$ in the scale of 10 = ·03 in the scale of 12.

Note.—(1) In the common or decimal notation the value of the figures representing any number increases from right to left, by powers of *ten*.

Thus, $7296 = 7 \times 10^3 + 2 \times 10^2 + 9 \times 10 + 6$.

Now, although this employment of 10 as the *radix*, as it is called, of our scale of notation is convenient, it is quite arbitrary; and we might express any number by means of powers of any other number than 10.

For instance, if 4 were taken as the radix of the scale of notation, 2312 would denote $2 \times 4^3 + 3 \times 4^2 + 1 \times 4 + 2$.

Similarly, if 8 were the radix of the scale, 5764 would mean $5 \times 8^3 + 7 \times 8^2 + 6 \times 8 + 4$.

The numbers here represented by 2312 and 5764 are said to be expressed in the scales of 4 and 8 respectively.

It is evident that each of the figures or digits which occur in any scale must be less than the radix of the scale. Thus, in the scale of 4, the largest digit or figure which can occur is 3; in that of 8, 7; and similarly for other scales.

Suppose we take 12 for the radix of the scale, we must have symbols to represent the numbers 10 and 11. If we use *t* and *e* respectively for them, then 57*t*4*e*9 would mean

$5 \times 12^5 + 7 \times 12^4 + 10 \times 12^3 + 4 \times 12^2 + 11 \times 12 + 9$.

The scale of which the radix is 12 is called the *duodecimal* or *duodenary* scale.

(2) Your writing might obtain 70 per cent. of marks. It is *too small*.

4. INQUISITIVE.—The distance from A to B is $7\frac{1}{2}$ miles; a man can walk it in 2 hours 20 minutes, and return in 2 hours $17\frac{1}{2}$ minutes. He walks uniformly on both journeys at the following rates—up hill, 3 miles per hour; down hill, $3\frac{1}{2}$ miles per hour; and on the level at $3\frac{1}{3}$ miles per hour; how *much level* is there between A and B? (*Dublin University B.A. Paper.*)

Let x = level ground between A and B in miles,

And let y = up-hill ,, from A to B in miles;

Then $7\frac{1}{2} - (x+y)$ = down-hill ,, ,, ,, ;

∴ y = ,, ,, ,, B to A ,, ;

And $7\frac{1}{2} - (x+y)$ = up-hill ,, ,, ,, ,, ;

$$\therefore \begin{cases} (1)\ \frac{x}{3\frac{1}{3}} + \frac{y}{3} + \frac{7\frac{1}{2} - (x+y)}{3\frac{1}{2}} = 2\frac{1}{2} \\ (2)\ \frac{x}{3\frac{1}{3}} + \frac{7\frac{1}{2} - (x+y)}{3} + \frac{y}{3\frac{1}{2}} = 2\frac{7}{22} \end{cases}$$

$$\begin{cases} (1)\ \frac{4x}{13} + \frac{y}{3} + \frac{15 - 2x - 2y}{7} = \frac{7}{3} \\ (2)\ \frac{4x}{13} + \frac{15 - 2x - 2y}{6} + \frac{2y}{7} = \frac{44}{21} \end{cases}$$

$$\begin{cases} (1)\ 84x + 91y + 585 - 78x - 78y = 637 \\ (2)\ 672x + 5460 - 728x - 728y + 624y = 5005 \end{cases}$$

$$\begin{cases} (1)\ 6x + 13y = 52 \\ (2)\ -56x - 104y = -455 \end{cases}$$

$$\begin{cases} (1)\ 48x + 104y = 416 \\ (2)\ 56x + 104y = 455 \end{cases}$$

$8x = 39$

∴ $x = 4\frac{7}{8}$.

∴ Level ground = $4\frac{7}{8}$ miles. Ans.

5. R. J. SMITH.—Solve:—

$$2x^2 + 6x = 226 - \sqrt{x^2 + 3x - 8}. \quad (\textit{Todhunter.})$$

$$2x^2 + 6x = 226 - \sqrt{x^2 + 3x - 8}$$

$$x^2 + 3x = 113 - \tfrac{1}{2}\sqrt{x^2 + 3x - 8}$$

$$(x^2 + 3x - 8) + \tfrac{1}{2}\sqrt{x^2 + 3x - 8} = 113 - 8 = 105$$

$$(x^2 + 3x - 8) + \tfrac{1}{2}\sqrt{x^2 + 3x - 8} + (\tfrac{1}{4})^2 = 105 + \tfrac{1}{16} = 105\tfrac{1}{16}$$

$$\sqrt{x^2 + 3x - 8} + \tfrac{1}{4} = \pm 10\tfrac{1}{4}$$

$$\sqrt{x^2 + 3x - 8} = \pm 10\tfrac{1}{4} - \tfrac{1}{4} = 10, \text{ or } -10\tfrac{1}{2}.$$

(The minus value is inapplicable, as the square root of a positive quantity is positive.)

$$\sqrt{x^2 + 3x - 8} = 10$$

$$x^2 + 3x - 8 = 100$$

$$x^2 + 3x = 108$$

$$x^2 + 3x + (\tfrac{3}{2})^2 = 108 + \tfrac{9}{4} = 110\tfrac{1}{4}$$

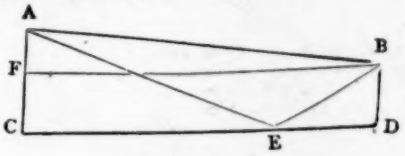
$$x + \tfrac{3}{2} = \pm 10\tfrac{1}{2}$$

$$x = \pm 10\tfrac{1}{2} - \tfrac{3}{2}$$

$$\therefore x = 9, \text{ or } -12.$$

Mensuration.

1. CONSTANT SUBSCRIBER.—There are two upright pillars in the same horizontal plane, whose heights are respectively 44 ft. and 28 ft. A certain point is taken in that plane between the two pillars, and it is found that the distance of *this point* from the top of the higher pillar is 125 ft., and from the top of the shorter pillar is 53 ft. Find the distance between the tops of these pillars. (*Hiley.*)



$$CE^2 = AE^2 - AC^2$$
$$= 125^2 - 44^2$$
$$= 15625 - 1936$$
$$= 13689;$$
$$\therefore CE = 117.$$

$$DE^2 = BE^2 - BD^2$$
$$= 53^2 - 28^2$$
$$= 2809 - 784$$
$$= 2025;$$
$$\therefore DE = 45.$$

$$CD = CE + DE$$
$$= 117 + 45$$
$$= 162.$$

$$AB^2 = AF^2 + FB^2$$
$$= (44 - 28)^2 + CD^2$$
$$= 16^2 + 162^2$$
$$= 256 + 26244$$
$$= 26500;$$
$$\therefore AB = \sqrt{26500}$$
$$= 162\cdot 788\ldots\ldots$$

∴ Distance between the tops of the pillars

$= 162\cdot 788\ldots$ ft. Ans.

2. BON SOIR.—A tent is made in the form of a conic frustrum surmounted by a cone of a different angle. The diameters of the base and top of the frustrum are 14 ft. and 7 ft., its height is 8 ft., and the height of the tent 12 ft.; find the quantity of canvas required for it. (*Excise*, Nov., 1883.)

Slant height of lower part $= \sqrt{8^2 + (3\frac{1}{2})^2}$ ft.

$= \sqrt{64 + \frac{49}{4}}$ ft.

$= \sqrt{\frac{305}{4}}$ ft.

$= \frac{17\cdot 4642\ldots}{2}$ ft.

$= 8\cdot 7321\ldots$ ft.;

,, ,, upper ,, $= \sqrt{4^2 + (3\frac{1}{2})^2}$ ft.

$= \sqrt{16 + \frac{49}{4}}$ ft.

$= \sqrt{\frac{113}{4}}$ ft.

$= \frac{10\cdot 63\ldots}{2}$ ft.

$= 5\cdot 315\ldots$ ft.;

Quantity of canvas required for lower part

$$= \left\{ \frac{(14+7) \times 3{\cdot}14159}{2} \times 8{\cdot}7321 \right\} \text{ sq. ft.}$$

$$= \frac{576{\cdot}086238819}{2} \text{ sq. ft.}$$

$$= 288{\cdot}0431194095 \text{ sq. ft.}$$

Quantity of canvas required for upper part

$$= \left(\frac{7 \times 3{\cdot}14159}{2} \times 5{\cdot}315 \right) \text{ sq. ft.}$$

$$= \frac{116{\cdot}88285595}{2} \text{ sq. ft.}$$

$$= 58{\cdot}441427975 \text{ sq. ft.}$$

∴ Quantity of canvas required for the tent

$$= (288{\cdot}0431194095 + 58{\cdot}441427975) \text{ sq. ft.}$$

$$= 346{\cdot}4845473845 \text{ sq. ft.}$$

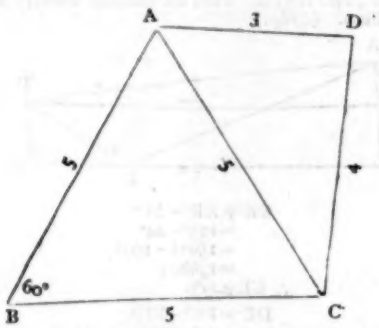
$$= 38 \text{ sq. yds. } 4{\cdot}4845473845 \text{ ft.}$$ Ans.

3. CHRONONHOTONTHOLOGOS.—The diagonals of a quadrilateral are 26 ft. and 24 ft. respectively, and they are at right angles; find the area. (*Todhunter.*)

Area of quadrilateral $= \frac{1}{2}(26 \times 24)$ sq. ft. $= (26 \times 12)$ sq. ft.

$= 312$ sq. ft. Ans.

4. YELSERP.—The sides of a quadrilateral taken in order are 5, 5, 4, and 3 feet respectively, and the angle contained by the first two sides is 60°; find the area. (*Todhunter.*)



In the triangle ABC, the sides AB, BC are equal, and the angle ABC is 60°, therefore it is equilateral.

As the sides of the triangle ADC are 3, 4, 5 respectively, it is right-angled, as $5^2 = 3^2 + 4^2$.

Area of equilateral triangle ABC $= \text{Side}^2 \times {\cdot}433$

$= 5^2 \times {\cdot}433 = 10{\cdot}825$;

,, right-angled triangle ADC $= \frac{1}{2}(3 \times 4) = 6$;

∴ Area of quadrilateral $= (10{\cdot}825 + 6)$ sq. ft.

$= 16{\cdot}825$ sq. ft. Ans.

5. M. A. M.—A public park surrounded by an iron railing measures 205 yds. long by 79 yds. broad. Inside the railing there is a gravel walk 6 feet wide. How many sq. ft. are in this walk?

Area of walk $= [\{(205+79) - (2 \times 2)\} \times 2 \times 2]$ sq. yds.

$= [\{284 - 4\} \times 4]$ sq. yds. $= [280 \times 4]$ sq. yds.

$= 1120$ sq. yds. $= 10{,}080$ sq. ft. Ans.

6. TREBOR.—In turning a one-horse chaise within a ring of a certain diameter, it was observed that the outer wheel made 3 turns while the inner wheel made 2. The wheels were of equal height; and supposing them fixed at a distance of 5 feet asunder on the axle-tree, what was the circumference of the track described by each wheel? (*Nesbit.*)

Circumference of inner track : Circumference of outer track

:: 2 : 3,

∴ Diameter of inner track : Diameter of outer track

:: 2 : 3,

Diameter of inner track : Diameter of inner track + 5 ft. × 2

:: 2 : 3,

∴ 3 times diameter of inner track

$= 2$ (diameter of inner track + 10 ft.)

= Twice diameter of inner track + 20 ft.

∴ Diameter of inner track = 20 ft.,

,, ,, outer ,, = 30 ft.;

∴ Circumference of inner track $= (20 \times 3{\cdot}1416)$ ft.

$= 62{\cdot}832$ ft.

,, ,, outer ,, $= (30 \times 3{\cdot}1416)$ ft.

$= 93{\cdot}248$ ft.

7. SEMPER FIDELIS.—A solid metal sphere of 6 inches diameter is formed into a tube 10 inches in external diameter and 4 inches in length. Find the thickness of the tube.

Solidity of sphere $= (6^3 \times {\cdot}5236)$ cub. in. $= (216 \times {\cdot}5236)$ cub. in.;

Solidity of tube = (External diameter^2 − internal diameter^2) × ·7854 × length

$= \{(10 \text{ in.})^2 - \text{internal dia.}^2\} \times {\cdot}7854 \times 4$ in.

$= (100 \text{ sq. in.} - \text{internal dia.}^2) \times 3{\cdot}1416$ in.;

∴ $(100 \text{ sq. in.} - \text{internal dia.}^2) \times 3{\cdot}1416$ in.

$= (216 \times {\cdot}5236)$ cub. in.,

$$100 \text{ sq. in.} - \text{internal dia.}^2 = \frac{(216 \times {\cdot}5236) \text{ cub. in.}}{3{\cdot}1416 \text{ in.}} = 36 \text{ sq. in.}$$

Internal dia.^{2} = 100 sq. in. − 36 sq. in. = 64 sq. in.

∴ Internal diameter = 8 inches.

Thickness of ring $= \frac{1}{2}$ (external diameter − internal diameter)

$= \frac{1}{2}(10 \text{ in.} - 8 \text{ in.}) = 1$ inch. Ans.

8. DEVA.—Two large circles are concentric with one which encloses 3927 ft.; find their radii (working to four places of decimals) so that the areas lying between the given circle and the second, and between the second and the outermost, may each equal the area of the given circle. (*Excise Exam.*, Nov., 1883.)

Area of second circle $= (3927 \times 2)$ sq. ft. $= 7854$ sq. ft;

Diameter ,, $= \sqrt{7854 \text{ sq. ft.} \div {\cdot}7854}$

$= \sqrt{10{,}000 \text{ sq. ft.}} = 100$ ft.;

∴ Radius ,, $= 50$ ft.

Area of outermost circle $= (3927 \times 3)$ sq. ft. $= 11{,}781$ sq. ft.;

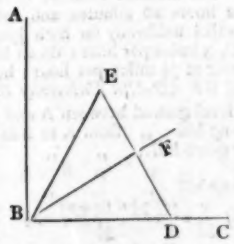
Diameter ,, $= \sqrt{11{,}781 \text{ sq. ft.} \div {\cdot}7854}$

$= \sqrt{15{,}000 \text{ sq. ft.}} = 122{\cdot}4744\ldots$ ft.;

∴ Radius ,, $= 61{\cdot}2372\ldots$ ft.

Geometry.

1. E. COUMBE.—Trisect a right angle.



Let ABC be a right angle.

In BC take any point D, and upon BD describe an equilateral triangle BDE; (I. 1.)

Bisect the angle DBE by the straight line BF; (I. 9.)

Then BE and BF trisect the right angle ABC.

Proof.—The triangle BDE is equilateral, and therefore equiangular; (I., 5, Cor.)

The angles of a triangle are together equal to two right angles; (I. 32.)

∴ Angle DBE = $\frac{2}{3}$ of a right angle.

Wherefore angle ABE = $\frac{1}{3}$,, ,,

And angle DBE is trisected by BF,

∴ Each of the angles DBF, EBF = $\frac{1}{3}$ of a right angle.

Wherefore BE and BF trisect the right angle ABC.

Q. E. F.

General.

1. J. A. SIMPSON.—*Huxley* or *Findlater's* 'Physiography,' or *Langler's* 'Popular Astronomy' (Hughes), for the outlines of the subject.

2. ALLOTT EDDLEBERT will see the diagrams required in any atlas or large work on Astronomy. They may in due course appear in our own pages.

3. TEACHER.—No doubt the following explanation will remove your difficulty :—

$x^m \div x = x^{m-1}$, as the index of x is unity ;

$x^{m-1} \div x = x^{(m-1)-1} = x^{m-2}$.

4. E. COUMBE.—The solution of your query appeared in our issue for October, 1882.

5. MACDERMOT.—You will find the solution of your query in our issue for December, 1883.

6. E. SANDERS.—Your query was solved in our issue for April, 1882.

7. RAJAH.—(1) The solution of your query appeared in our issue for July, 1883. (2) We believe your writing would obtain the full percentage of marks.

8. CIVIL SERVICE INQUIRER.—Your writing is good, and would probably receive 80 per cent. of the marks awarded. Mr. Winch's handwriting (Dictation) in our last number will prove a capital model for you.

9. SUBSCRIBER.—The term *Rider* is applied to a deduction from any proposition of Euclid, because the deduction is borne up or supported by the mathematical reasoning worked out in the proposition, as a horseman, or *rider*, is supported or carried by the horse that he bestrides ; or, in other words, that the proposition carries the deduction on top of it, as it were, as the horse carries its rider.

10. MAYFLOWER.—Rule for Cube Root :—

(1) Divide the number into periods, by marking off every three figures, beginning with the unit's place. The number of periods will denote the number of figures in the root.

(2) The first figure of the root is the figure whose cube is the greatest cube in the first period. Subtract this cube from the first period, and bring down the next period.

(3) Multiply the square of the root already found by 300 to form a divisor, and from this determine the next figure in the root. (As the real divisor will be larger than this divisor, allowance must be made for this in determining the next figure.)

(4) The real divisor will be the sum of the following :—
- (*a*) The divisor already given.
- (*b*) The continued product of the root already found, the last figure in the root, and 30.
- (*c*) The square of the last figure in the root.

(5) Multiply this divisor by the last figure in the root, and subtract the product from the dividend, and bring down the next period.

(6) Form a divisor and find another figure in the root by exactly the same process, continuing the operation until all the periods are exhausted.

Note.—In decimals the periods are marked to the right, and if there are not sufficient figures to complete periods, ciphers must be added.

If there be a remainder, then the given number has no exact cube root, but an approximation can be carried to any degree of nearness by adding ciphers, and finding any number of decimal places.

Example :—Find the cube root of 11543·176.

		11 543·176(22·6
		8
$2^2 \times 300 = 1200$	3543	
$2 \times 2 \times 30 = 120$		
$2^2 = 4$		
1324	2648	
$22^2 \times 300 = 145200$	895176	
$22 \times 6 \times 30 = 3960$		
$6^2 = 36$		
149196	895176	

11. BRACHY HEAD.—Parse and analyse, 'What boy has not learned his lesson that I gave him yesterday ?'

What—interrog. pro., used as an adj., qual. *boy*.
boy—com. noun, mas., sing., 3rd., nom. to *has learned*.
has—aux. verb to *learned*, indicating perfect tense.
not—adv. of mood (negation), modifying *has learned*.
learned—past part. of *to learn*, refg. to *lesson*.
has learned—reg. trans. verb, act., ind., perfect, 3rd, sing., agreeing with *boy*.
that—rel. pro., neut., sing., 3rd, obj., gov. by *gave*.
I—per. pro., com., sing., 1st, nom. to *gave*.
gave—irreg. trans. verb, act., ind., past, 1st, sing., agreeing with its nom. *I*.
him—per. pro., mas., 3rd, sing., obj., gov. by *to* understood.
yesterday—adv. of time, modifying *gave*.

Sentence.	Kind of Sent.	Subject.	Predicate.	Object.	Extension.
(*a*) What boy has not learned his lesson	Prin. Sent.	What boy	has learned	his lesson	not (negation)
(*b*) That I gave him yesterday	Adj. to *lesson* in *a*	I	gave	that (dir.) him (ind.)	yesterday (time)

12. RUSTICUS.—The solution of your query appeared in our issue for June, 1883.

13. TANGENT.—Show how to find $\tan \frac{A}{2}$ when $\tan A$ is given.

$$\text{Tan } A = \frac{2 \tan \frac{A}{2}}{1 - \tan^2 \frac{A}{2}}$$

$$\tan A \left(1 - \tan^2 \frac{A}{2}\right) = 2 \tan \frac{A}{2}$$

$$\tan^2 \frac{A}{2} + \frac{2 \tan \frac{A}{2}}{\tan A} = 1$$

$$\tan^2 \frac{A}{2} + \frac{2 \tan \frac{A}{2}}{\tan A} + \left(\frac{1}{\tan A}\right)^2 = 1 + \frac{1}{\tan^2 A}$$

$$= \frac{\tan^2 A + 1}{\tan^2 A}$$

$$\tan \frac{A}{2} + \frac{1}{\tan A} = \frac{\pm \sqrt{\tan^2 A + 1}}{\tan A}$$

$$\therefore \tan \frac{A}{2} = \frac{\pm \sqrt{\tan^2 A + 1} - 1}{\tan A}.$$

14. AOLIS NEP will find instruction on taking up ladder in any good book on stocking-knitting. Miss. Jones's manual of *Plain Needlework and Cutting-out* will be published in a few days (Hughes).

15. C. B. ELLISON's writing is good, and of the right kind. With such command of the pen he should strive after uniformity. With better 'capitals,' fully eighty-five per cent.

16. C. RIDGE's question is difficult ; there are so many text-books on geography. Langler's is good summary. Clyde's is fuller and descriptive.

17. A CONSTANT READER will find his qualification under Art. 50 (Old Code, Art. 79) of no value in the Colonies. Indeed, an English certificate does not, in most cases, exempt from examination by the Boards of Education in the Colonies.

18. HOREB might obtain seventy per cent., and easily add ten or fifteen more if he would study his capitals.

19. INQUIRER.—You will find the solution of your query in our issue for February, 1882.

20. J. HENTON.—This correspondent has kindly sent the following difficult question, which was given to Std. V. in a recent examination :—

	Hhd.	bar.	kil.	fir.	gals.
From	1	0	0	0	0
Take		1	0	1	2
					7

The difficulty arises from the fact that 3 kilderkins = 1 hogshead, and 2 kilderkins = 1 barrel, and therefore the question is:—From 3 kilderkins take 2 kilderkins 1 fir. 2 gals., and the answer is 7 gals.

21. H. T.—Your problem resolves into a cubic equation, which has no exact roots. One number lies between 81 and 82, and the other between 18 and 19.

22. CORRESPONDENT.—You will obtain the correct *signs* by the following method:—

$$\begin{aligned}(a-b-c)^2 &= \{(a-b)-c\}^2\\ &= (a-b)^2 - 2(a-b)c + c^2\\ &= a^2 - 2ab + b^2 - 2ac + 2bc + c^2\\ &= a^2 + b^2 + c^2 - 2ab - 2ac + 2bc.\end{aligned}$$

$$\begin{aligned}(a-b-c)^3 &= \{(a-b)-c\}^3\\ &= (a-b)^3 - 3(a-b)^2 c + 3(a-b)c^2 - c^3\\ &= a^3 - 3a^2b + 3ab^2 - b^3 - 3(a^2 - 2ab + b^2)c\\ &\quad + 3ac^2 - 3bc^2 - c^3\\ &= a^3 - 3a^2b + 3ab^2 - b^3 - 3a^2c + 6abc - 3b^2c\\ &\quad + 3ac^2 - 3bc^2 - c^3\\ &= a^3 - b^3 - c^3 - 3a^2(b+c) + 3b^2(a-c)\\ &\quad + 3c^2(a-b) + 6abc.\end{aligned}$$

23. INCOGNITO.—We do not reply to anonymous queries.

24. CLARIBEL will find the '*darning*' required in Standards V., VI., and VII. specified in the Third Schedule of the Code. She will be careful to note that some parts of the work are optional. See reply o Aolis Nep.

25. SEMPER FIDELIS.—Very good writing. Full marks if the looped letters were uniform.

26. DELTA.—*Skeats'* 'Etymological Dictionary' will be useful. 'Mrs. Shimmelpenninck's Life' is reported 'out of print.'

27. A SUBSCRIBER will find several 'Notes of Lessons' for infants advertised. *Singleton's* (pub. by Jarrold) is suggestive.

28. JOHN STUART must obtain permission of the Education Department to enter the Civil Service. He may have to repay some part of the cost of his training.

29. PRO BONO PUBLICO must improve in his writing. The syllabus for 'Scholarship' is implied in Schedule V. Last year's questions have been published.

30. HOPEFUL is bound to complete his apprenticeship under the prescribed conditions. He cannot 'skip a year.' Writing too uneven to gain more than 70 per cent.

31. A PUPIL TEACHER'S writing lacks firmness, and his text-hand and capitals must be *studied* to secure right proportions—and more than 65 per cent.

32. J. P. RADCLIFFE.—*Findlater's* or *Huxley's* 'Physiography.'

33. IDES.—Possibly; but the questions in geography may range over 'The World.'

34. H.—Purchase *Mulhauser's* 'Method of Teaching Writing.'

35. S. MADDOCKS.—The second specimen of writing is the better, because more uniform, and would gain at least 80 per cent. One translation is given this month. It is nearly literal; for, from the incorrect copying, you are evidently a beginner.

36. EDGAR QUINET.—The poems of the Troubadours. If we desire to form a correct idea of the effect which these poems could produce we must picture to ourselves the solemn assembly at the fêtes (festivals) which accompanied them. During the six months of winter the feudal castle had remained enveloped in clouds. No tournaments, no war; few strangers and (few) pilgrims; long, monotonous days, and sad, interminable (long, weary) evenings, poorly filled up by the game of chess. At length spring-time had arrived; the lady (of the feudal chief) had gathered the first violet in the orchard. With the swallows was expected the return of the Troubadour. On some fine day in the month of May he sent his singers and jugglers to recite his old romances to the burgesses and common people in the interior of the small towns; but he himself pursues the steep slope which leads to the castle. Without delay, from the (very first) evening of his arrival, the barons, esquires, and ladies assemble in the great paved hall to hear the poem which he has (just) completed during the winter. The Troubadour, in the midst of the assembly, does not read; he recites. But when his recital becomes elevated, he sings at intervals, accompanying himself on the harp or viol. His introduction is full of pride and ingenuousness. At the same time, it is a picture of the assembly.

> 'Sirs, now, make silence, knights and barons,
> Kings and dukes, counts and princes of renown,
> Prelates and burgesses, people of religion,
> Matrons and maidens, and little children.'

37. TROUBLESOME.—*Bacon's* 'Essays,' by Lewis, Vol. I.; 'Political Economy,' by *Mrs. Fawcett*; the 'Royal History of Scotland,' published by Nelson.

38. EX-P.-T.—*Clyde's* 'Geography'; *Mansford's* or *Fitch's* 'Arithmetic.' We know of no book consisting *wholly* of examples of analysis.

39. T. E. M. TEACHER cannot write text-hand with regularity; but the small-hand is good.

40. ODYSSEUS.—We have not yet seen a separate edition of Book IX.

41. SEPOY will find *Whittier's* poem on the relief of Lucknow ('The Pipes,' etc.) in several collections. We last met with it in Isbister's 'Fourth Standard.'

42. WAT TYLER.—Mr. Winch holds four Advanced Science Certificates, and "D" (Full Drawing Certificate).

—o—

Article 106 (*b*)

Merit Grant in Infant Schools.

BY MRS. MORTIMER,

Lecturer on Kinder-garten at the Home and Colonial Training College, London.

LESSON—RICE.

CLASS—CHILDREN OVER SIX.

Apparatus:—Some rice and corn (wheat and barley); picture of rice plant; ears of wheat and barley.

I. *Description.*—Some rice should be shown to the children, and they should be asked to describe it. It consists of a number of little pieces. What do you call these little pieces? What have you seen before that is made up of little grains. What is the difference between the grains of rice and the grains of sugar? Tell me some other things in little grains. Wheat, oats, barley, etc.

Let us look at one of these grains of rice. What can you tell me about it? It is white and very hard, and of an oval shape. What else do you know that is of an oval shape? An egg. The children should then repeat, 'A grain of rice is white, hard, and oval in shape.'

II. *Whence obtained.*—We get rice from a plant called the rice plant. See, here is a picture of it. Have you ever seen a plant anything like this? Yes, it is very much like the corn plant. Who can tell me which corn plant it is like? It is something like barley. Do you know how barley differs from wheat and oats? The seed part or the ears are covered with long hair-like pieces. Yes, we call that the *beard*, and I daresay you have heard people speaking about *bearded* barley. The teacher, then directing the attention of the children to the picture of the plant, should point out the arrangement of the ear. The seeds are contained in it. The ear grows out of the stem. The children should have specimens of the ear and stalk of the corn plants shown them. The children's attention should next be directed to the stem, and a comparison should be made with some familiar object about as high as the rice plant. The children should then repeat, 'The rice plant grows to a height of six feet.' The teacher would have to tell the children that the rice plant grows in very damp, muddy places. There are plenty of such places in England, but still, the rice plant will not grow here. This is because it wants something else to make it grow. It will only grow in very hot countries. In the parts where it grows the land is covered with water for

some time, then the water runs off the land; and what do you think the land is like? It is like mud. Yes, that is the best thing for the rice to grow in. There is one place where the rice seeds are thrown into the water. I suppose if you were to see people sowing seeds like this you would think they were very silly. When the water goes away the men go and look after the rice, and they find it has already begun to grow. When it has grown high, and the ears are ripe, they cut it down just in the same way as the corn is cut in our country. They use a knife, however, that is rather different. The long steel part is not sharp like those our farmers use, but is like a saw; that is, all cut into teeth.

The men have to cut the rice down very quickly, and get it away before the water comes back again. If the water were to come before it was cut down, it would be spoilt, and then you know it would not be any good.

Can you tell me which part of the rice plant we eat? Yes, the seeds. When you get wheat from the field, and are going to eat it, what do you first do? Pull off all the skins. These skins are called husks. Well, the rice seeds are covered with husks, and before we use the rice they have to be taken off. This is generally done before the rice is sent to England. The children should then repeat, 'We eat the seeds of the rice plant after the husks are taken off.'

III. *Uses.*—For what do we use rice? For eating. What must be done to it before you can eat it? It must be cooked, so as to make it soft. How is it cooked? Sometimes it is boiled, and sometimes it is made into puddings. What is put with the rice when it is made into puddings? Eggs, milk, and sugar.

Sometimes it is made into cakes. Do we use the same rice for puddings and cakes? No, the rice for cakes has been ground into a powder. What is it like then? It is like flour. Yes, and we call it 'ground' rice.

Of what do we make bread? Of flour. Can you tell me of what flour is made? Yes, wheat is ground, and then it is called flour, and this flour is made into bread. Well, in some countries people grind the rice into flour, and use it for making bread. I do not think you would like this bread; it is not so nice as the bread made of 'wheat' flour, and very soon gets very hard and dry. The children should then repeat, 'Some people use ground rice to make bread.' Do you know what your mother uses when she wants to make your collars and dresses stiff? She uses starch. A great deal of starch is made from rice. The children should then repeat, 'Rice is used for making starch.'

Do you remember the long stalks of the rice plant? Now these are very useful for making hats and bonnets. What kind of hats do we call these? Straw hats. These hats are quite white. Do you see this beautiful thin paper? It is called rice paper, and is so called because it is made from rice.

IV. *Summary.*—This should consist of very simple words, and should be written on the board as the lesson proceeds.

Rice is white and hard. It grows in hot, muddy places.

The plant is like our corn plants. Rice is used for food.

In some places it is made into bread. Starch and paper are made from rice.

LESSON—THE APPLE AND PEAR.

CLASS—CHILDREN UNDER SIX.

Apparatus:—Apple and pear; pictures of the apple and pear trees.

I. *Description.*—An apple should be placed before the children, and after they have named it, they should be asked to describe it. It is round and green. Are all apples green? No, some are red, some brown, some yellow. When are apples of these colours? When they are ripe. Feel this apple. What can you say about it? It is smooth, and rather hard. What do you call this part of the apple? The stalk. Of what use is it? The apple is joined to the tree by it. Do you know what this is called? Yes, it is the eye of the apple. Now see what I have done. Cut the apple in half. What can you say of this? It is the inside of the apple. Is it green like the outside? No, it is of a very pale yellow. That is right; some apples are quite white inside. What part is green? The skin. Where is the skin? On the outside of the apple. Do you notice any other difference between the inside and outside of the apple? Yes, the outside is dry, and the inside is wet. What makes the inside wet? The juice.

Now I want you to look quite in the middle of this half of the apple. Do you know what there is there? Yes, some pieces of skin, and some pips. What do we call this part of the apple? The core. What are the pips like? They are like seeds. What colour are they? They are dark brown. Yes, they are the seeds, and when they are brown, the apples are ripe. You have all tasted apples. Can you tell me what kind of taste they have? A nice sweet taste. Always? No, sometimes they taste sour. When is this? When they are not ripe. There are some apples that are never sweet, not even when they are ripe. They are called cooking apples.

The children should then be asked to name the different parts of an apple. The skin, the stalk, the eye, the inside, the juice, the core, and the pips.

The teacher should now show a pear to the children, and ask them to name it. What can you say about the pear if you compare it with the apple? It is not as round as the apple is; it is longer, and comes to a point. Which end comes to a point? The end where the stalk is. What is at the thick end of the pear? The eye. What colour is it? Brown; some are green and some yellow. What had the apple on the outside? A skin. Well, if I cut this pear, you will see that it also has a skin. What difference do you notice about the inside? It is much softer than the apple. The children should then repeat, 'The inside of the pear is softer than that of the apple, and is more juicy.'

What did we find in the centre of the apple? The core. Now look at the pear; is there a core in it? Yes, and there are pips there, but they are quite black. Do the apple and pear taste the same? No, they both have a sweet taste, but they are very different.

II. *Whence obtained.*—From where do we get apples and pears? From trees in the garden. Do you know what kind of trees they are? They are generally large trees, though you will often see small ones with very nice fruit on them. What time of the year do we get apples and pears? If you were to watch an apple-tree you would see that all the winter-time the tree was quite bare and looked as if it were dead. Then when the weather begins to get warm, a great many pretty flowers are seen all over the tree, and at the same time green leaves are beginning to come. Then you would see that when these flowers fade away very small apples have come. These get larger and larger, and the green leaves also get large. Then when summer comes, and the nice warm weather, these apples get ripe, and instead of being green they become red, brown, etc. Sometimes the wind blows the apples off the tree and we are able to pick them up. It would not do for us to wait for the wind to blow all the apples and pears off the trees, for when they fall they get knocked and soon go bad. Men have to pick them. They get ladders and put against the thick branches, and pick the apples off, and put them in baskets. When they are picked like this they keep a long time. Sometimes there are a great many trees, and the men either shake the apples off, or use long sticks and beat the trees, and this knocks all the apples down. Women and children then pick them up and put them in baskets.

When there are a great many trees in a garden we call it an orchard.

III. *Uses.*—For what do we use apples? For eating. What else? They are put into puddings and pies. Sometimes they are made into jam and jelly. Pears are also used for eating. Do we make puddings and pies of pears? Not in this country.

IV. *Summary.*—An apple is round, and of different colours. The parts of the apple and pear are—the stalk, the eye, the skin, the inside, the juice, the core, and the pips. They grow on trees. They are used for eating. Apples are made into puddings, pies, and jelly.

LESSON—LEATHER.

CLASS—CHILDREN OVER SIX.

Apparatus:—Some pieces of leather and skin, a slate, duster, some water.

I. *Qualities.*—Some leather should be shown to the children, and they should be asked to say what they can about it; by looking at it they will see that it is of a brown colour. The teacher, bending a piece of leather, should ask, What am I doing? Bending the leather. Tell me some other things that you can bend? What do we say of all these things? They are flexible. The children should now repeat, 'Leather is flexible.'

Now, Mary, I want you to come and hold this piece of leather in one hand, and this slate in the other. You see they are both about the same size, but what can you tell me about the weight? The slate is heavier than the leather. We say leather is light. The children should repeat this. What have I in my hand now? A duster. What am I doing? Pouring some water on it. What do you notice about that water? It has gone through the duster; there is no water left on the top of it, where it was all poured. Watch again. What am I doing now? Pouring some water on the leather. What do you notice this time? The water is still on the leather; it does not run through. Tell me some other things that will not let water through? Slate, china, glass, etc. What do we say of these things? They are waterproof. The children should then repeat, 'Leather is waterproof.'

For what do we use leather? For making boots and shoes. Yes, this is one of the great uses of leather. Why do we not use calico, cloth, or even felt for our boots? Yes, they would very soon wear into holes. Because leather lasts a long time we say it is durable. Why do we say leather is durable?

II. *Uses.*—You have already told me one use of leather. What is it? For making boots and shoes. Can you tell me anything else that is made of leather? Bags, straps, harness, gloves, aprons, etc. You see leather is used for making a great many things. We say it is very useful. Can you tell me why it is so useful for making boots and shoes? Let us read from the blackboard all we found out about leather, and then think which of these qualities make it useful for making boots. The first quality is flexible. What does that mean? Do we need leather to be flexible in order to make boots of it? Yes, it is very much better to have something that will bend than anything quite stiff. When we move our feet, our boots bend a little, too; this makes them comfortable, and keeps them from hurting our feet: sometimes your boots hurt your feet, but that is when you have made them very wet, and then dried them too quickly. What does this do to your boots? Makes them very hard and stiff. What must you do to your boots to make them soft again? Grease them. Yes, then they become flexible again, and do not hurt you when you wear them. Now, what is the next quality? Light. Do we like our boots light? Why do we not like boots made of something heavy? They would make us very tired. The next quality is waterproof. What does that mean? Do we need our boots to be waterproof? Why? Because we sometimes have to go out in the rain, and our feet would get wet if our boots were not waterproof. Sometimes your boots do let the water through. When is that? When they are wearing out. What has to be done to them then? They have to be mended, or else we must have new ones.

Now, there is still one more quality that makes leather so useful for boots. What is that? It is durable. What does this mean? The children should now repeat, 'Leather is useful for making boots and shoes, because it is flexible, waterproof, light, and durable.'

III. *Whence obtained.*—Can any one tell me where we get leather? Well, I will tell you; it is made from the skins of different animals. You can tell me some—the horse, cow, goat, etc. The children should now repeat, 'Leather is made from the skins of animals.'

Now, I want you for a moment to look at your own skin: touch the skin of your hands, and of your face. If you run fast in the summer-time, how do you feel? Very hot. What do you sometimes see on your face and hands when you are very hot? Little drops of water. What do we call this? Perspiration. Where does it come from? From under the skin. How does it get outside the skin? It comes through. Yes, there are very little holes in the skin called pores, and it is through these that the perspiration comes. All animals' skin is full of these little pores like yours. I told you leather is made from skins—What is the difference between the skin and the leather? The skin lets water through—it is porous; and the leather will not let water through—it is waterproof. Would you like the skin to be made into boots? Why not? Something has to be done to the skins to make them waterproof before they are made into leather.

IV. *Summary.*—This should be written on the blackboard as the lesson proceeds:—

Leather is of a brown colour; it is flexible, light, waterproof, and durable.

Leather is used for making boots and shoes, bags, straps, harness, aprons, etc.

Leather is made from the skins of animals.

LESSON—THE SWALLOW.

CLASS—CHILDREN OVER SIX.

Apparatus:—Stuffed specimen of swallow; picture of several other birds for comparison.

I. *Description.*—The stuffed specimen of the swallow and the above-mentioned picture should be placed before the children so that the description of the swallow can be obtained by comparison. What kind of body has the swallow? It has a long slender body. With what is it covered? Feathers. If you feel these feathers, what can you say of them? They feel soft, smooth, and thick. What do you mean by saying they feel thick? Feel this one; does that feel thick? Oh, no. Well then? The feathers are close together, and there are a great many of them, and that makes them feel thick. If you look at them, what would you say of them? They are of a grey colour. What do you say, Mary? Rather a dirty-grey. And you, Harry? Yes; the feathers are of a bluish-grey. What else do you see? The top of the head is of a reddish-brown and the tail is black. Now look again at the feathers; what else can you tell me? They are glossy. What can you tell me about the swallow's tail? It is very broad and divided. Yes; because it is thus divided we say the swallow's tail is forked. Now look how wide it can open its mouth. What can you say of its legs? They are short and very thin. What do you see on its toes? Claws. What can you tell me about them? They are long and curved.

II. *Habits and Food.*—Where do you generally see swallows? Flying about in the air. Yes; it is getting its food while it is doing this. What do you think it is able to find in the air? Flies. Yes, and other small insects. The children should then repeat, 'The swallow lives on flies and other small insects.'

The teacher might here point out to the children that in fine weather the insects fly high in the air and the swallows do the same. In damp weather the insects come lower down, and you will see the swallows flying close to the ground. So you see if you watch the swallow you will be able to tell what kind of weather we are going to have. When does the swallow fly high in the air? For what does it do this? Why does the swallow fly close to the ground in damp weather? What part of the swallow enables it to fly so well and for so long a time? Its long, strong wings. You remember you told me that it had a very wide mouth, and if you look at the swallow

when it is flying you will see that its mouth is open; and its mouth is sticky, and the flies are thus easily caught. What kind of legs did you say the swallow had? Short and slender ones. Why does it not have strong legs? Because it does not need them. That is right; the swallow does not stand to get its food. Tell me a bird that stands to eat its food? The sparrow, robin. And now a large one? A hen.

You have told me that the swallow lives on insects and flies, which it catches in the air. Are these things always to be found in the air? When are they there? In the warm weather. Yes; when do we have warm weather? In the summer. What kind of weather do we have in the winter? Cold weather. Do you see the insects and flies in the winter? What do the swallows do then for food? If you look about you, you will notice that you never see swallows in the winter-time. Where do they go? Well, I will tell you. As soon as the weather begins to get cold, these birds fly away from us and go to a warmer country. You know that in our country the weather is cold in winter, but there are some countries where the weather is warm then. What do the swallows do? They fly away to warmer countries. When do they do this? When our winter is coming. And when do they come back to us? When the warm weather is coming again. Do you not think it is very wonderful that these little birds find their way back to us from countries such a long way off beyond the wide sea? And you must remember that they not only come back to the same country, but to the same place where they left their nest; and should they find the nest gone they seem to be very sorry and in great trouble. I hope you will not be unkind when you see a swallow's nest and knock it down. Would you like to know something about the swallow's nest? It is generally made of mud or clay, something the shape of a cup, and it is lined inside with soft grass, feathers, wool, and other things. Why does the swallow put these soft things inside its nest? To make it soft and warm. Why does it want it soft and warm? It lays its eggs in the nest, and sits on them and keeps them warm until the little birds come out of the shell. These little birds have hardly any feathers and cannot fly; so you see they want a nice warm house to live in. When these young birds grow up they will then make nests for themselves. (It would be well for the teacher to have a good model of a nest.) Have you ever seen a swallow's nest? Where did you see it? Under the roof of a house. Yes, the swallow likes to build its nest there. Sometimes the swallow builds its nest in the chimney. Why does not the nest get smoked? Because in the warm weather we do not have fires in the grate, and therefore there is no smoke to go through the chimney.

III. *Summary.*—This should be written on the blackboard as the lesson proceeds, and should afterwards be copied by the children or written from memory.

The swallow has a long slender body, which is covered with thick, soft, smooth, glossy feathers.

Its wings are very long and strong.

Its tail is broad and forked, and of a black colour.

It has a wide mouth covered with something sticky.

Its claws are long and curved.

The swallow lives on insects and small flies, which it catches while flying.

LESSON—SPONGE.

CLASS—CHILDREN OVER SIX.

Apparatus:—Piece of sponge; basin of water; a piece of wood.

I. *Qualities.*—A piece of sponge to be placed before the children, who should be asked what it is. What can you tell me about the sponge? It is of a brown colour; it is full of little holes. Do you know what we call these little holes? Yes, they are called pores. Can you tell me anything else that is full of pores? What do we say of all these things? They are porous. The children should repeat, 'Sponge is porous.'

Now tell me what I have done. Put the sponge into some water. When I lift the sponge out of the basin, what do you notice? The basin is empty. Where is the water? In the sponge. What does the sponge do when you put it into the water? Soaks it up. Name some other things that will soak up water? Blotting-paper, flannel, bread, etc. What do we say of all these things because they soak up water? They are absorbent. The class should now repeat, 'Sponge is absorbent.'

Now, when I squeeze the sponge, what happens? The water runs out into the basin again. Mary, will you come here and feel this sponge? Now put it into the water again. Now take it and hold it up. What difference do you notice? It is much heavier. What makes it so heavy? The water it has soaked up. How does the sponge feel? Soft. Does it always feel soft like this? No, if you let the sponge get dry, it gets hard, but you can very soon make it soft again. Do you know how? Yes, by putting it in some water.

What have I in my hand? A piece of sponge. And in this hand? A piece of wood. You see they are both the same size? The teacher taking up the sponge, and squeezing it in her hand, says, What can you tell me about the size of the sponge now? It is very much smaller. The teacher taking up the wood, and squeezing it in her hand, says, What am I doing now? Squeezing the wood. What can you say about the size of it? It is not altered. You cannot make it small like you can sponge. Now look at the sponge again. What happens directly I open my hand? The sponge springs back to its large size again. Do you know anything else like this? What is this? Elastic. What have I done to it? Stretched it. When I leave go what happens? It returns to its place. You see that is like the sponge, only you press the sponge, and you stretch the elastic; but in what are they alike? Directly you leave them go they return to their proper size again. Do you know what we say of those things that are like sponge? We say they are elastic. The children should now repeat, 'Sponge is elastic.'

II. *Uses.*—Now, children, for what do we use sponge? For washing ourselves. Why do we like sponge to wash with? Because it is so soft, and takes up a lot of water. Have you ever seen sponge used for anything else? Yes, you may sometimes see men cleaning cabs, carts, and carriages with sponge, and your mother also uses it to clean windows. Is this sponge like that we use to wash ourselves with? No, it is not so soft, and it is coarse; you would not like to use it for washing your face.

III. *Where found.*—Children to be asked if they know where sponge is found. If they do not know, tell them it is found in the sea, growing on rocks and plants. Men go into the sea and pick the sponge from the rocks. Would you like to go under the water to get the sponge? No, if you were to try to do it, you would be drowned. The men who go down have something on them, so that they can breathe under the water. They are called divers. They do not stop under the water long. They go down and come up very quickly again with some sponge; then they go down again for some more.

IV. *Summary.*—This should be written on the blackboard as the lesson proceeds:—

Sponge is of a brown colour; it is porous, absorbent, soft, and elastic.

Sponge is useful for washing ourselves; it is also used to wash windows, cabs, carriages, etc.

Sponge is found in the sea.

LESSON—HOW CHILDREN MAY BE USEFUL.

CLASS—THE BABIES.

Now, children, I want you to think about what you do all day, and then we will try and find out in how many ways you can help your mother. What are you doing all night? We are sleeping. Can you do anything to help your mother then? No. When do you wake up? In the morning. There is a little boy who says he woke

up in the night. Do you always wake up in the night? No, only sometimes. Now, there is something you can do to help your mother directly you wake up in the morning. Cannot you tell me? Some little children wake up very early, long before their mothers and fathers. These little boys and girls begin to play, and call out very loudly, and make such a great noise, that they wake their parents, who want to sleep. Can you tell me why they want to sleep? Because they are tired. Why are your mother and father so tired? Because they have to work so hard. So you see you ought not to wake them. Then the noise often wakes up the little baby, and then what does your mother have to do? Get up and nurse it until it goes to sleep again. Tell me, then, how you can help your mother in the morning when you first wake up? Yes, that is right; you must lie quite still, and not make any noise until your mother tells you it is time to get up. Then she will think you are very good for being so quiet. The children should then repeat, 'We help our mother when we lie still, and do not make any noise.'

When your mother says 'Get up,' what will you do? Jump out of bed directly, and try to dress ourselves. There are some little boys, and girls too, who do not get up directly they are told. Some like to sleep a little longer, and some like to play in bed instead of getting up. Well, their mother calls them once, then she has to come again, and sometimes again and again before these little boys get up. What does your mother have to do in the morning? Light the fire and get the breakfast ready. Well, you see she has plenty to do, and yet some little children will make her leave off her work several times to call them to get up. Is that the way to help their mother? No, it makes her work much harder. Who can tell me how you could help her instead of giving her more work to do? By getting up directly mother tells us, and trying to dress ourselves. Yes, some of you can quite dress yourselves, but some can only put some of your clothes on. Those who cannot dress themselves should let their brother or sister dress them. The children should then repeat, 'We can help our mother by getting out of bed directly she calls us, and getting ourselves dressed.'

When you are dressed you can do ever so many things to help your mother. First, you must remember that you always help most if you do what you are told at once, and do not want your mother to tell you to do the same thing over and over again. Then, perhaps your mother may want something that is upstairs. What can you do? We can run and fetch it for her.

When your mother is so busy she cannot very well look after baby, can you tell me how you can help her? We can play with baby and make it laugh, and baby likes this and will not cry. What does your mother have to do when baby cries? She has to nurse it. The children should then repeat, 'We help our mother when we play with the baby and keep it from crying.'

Now, when your mothers get you ready for school, they make you clean and put on clean pinafores, and try to make you look nice and tidy. Sometimes when little boys and girls are ready for school, they go into the garden or into the street and make themselves very dirty. What do their mothers have to do then? Make them clean again. Is that helping their mothers? No; their mothers have to do all the work over again. And what must they do with the dirty pinafores? They have to wash them. Now tell me then how you can help your mothers? By keeping ourselves clean when we are waiting to go to school. The children should then repeat, 'We help our mothers by keeping ourselves clean.'

Can you always keep yourselves clean? You cannot help getting dirty sometimes, and your mothers are not cross with you then. After you have been in school all day and have been playing, they expect to find you want washing and that your pinafores are dirty. It is only when you do something that you ought not to do and so get dirty, that your mothers are cross with you.

I dare say you will be able to do a great many other things to help your mothers when you are at home, but you must remember that you never help your mother if you are cross with one another, because that only makes her feel unhappy. Really the best way for little children to be useful, is for them to play with one another quietly, and to do what they are told directly.

LESSON—BEES.

CLASS—CHILDREN OVER SIX.

Apparatus:—Specimens of bees; large drawings showing the structure; some honeycomb, wax.

I. *Description.*—The specimens and drawings should be shown to the children, who would then readily recognise that the bee is divided into three parts, viz.: The head, the chest, and the abdomen or stomach. The children should then be exercised in pointing out the different parts.

Now look at the head of the bee; what can you see there? Two large eyes and something sticking out near its mouth. Yes, this is called its trunk. What animal do you know that has a trunk? The elephant. Yes, but there is a little insect you see flying about the window in the warm weather that has a trunk; what is its name? The fly. Yes, if you look at a fly on a piece of sugar, you will see that it stretches or puts out its trunk to the sugar. For what does it do this? To eat the sugar. Yes, and the bee uses its trunk just in the same way. Look at the body of the bee, and tell me what you notice. A great number of short hairs. How many legs has the bee? It has six. Now look very carefully at the back one and you will see there is a smooth hollow with thick hairs round it. This is called the basket. For what do you use baskets? Well, the bee uses it to carry the dust in. This dust is obtained from the flowers and forms the wax. Now look at the back part of the bee. Can you tell me anything about it? Yes, it has a sting there. What must you do when you see a bee? Keep out of its way, and not play with it. Why? Because it might sting you. Yes, and the sting of the bee is likely to make you very ill. Do you know why? Because it is poisonous. It is in this part of the bee that the honey is made.

II. *Habits.*—Who has ever seen a bee? What was it doing? Flying about from flower to flower. What does it do while on the flower? Yes, you see it puts its trunk right into the flower and gets something out. Do you know what that is? Yes, honey. Where does the bee take the honey? To its home. What do we call its home? The hive. See what I have here, do you know what it is? This is what the bees make to put the honey in. The young bees are also put in little spaces like these. We call each of these little spaces a cell. It is all called the honeycomb. Do you know of what it is made? Yes, of wax. This wax is the dust of the flowers. Do you remember the little basket on the bee's leg I showed you? This dust or pollen of the flower falls on the bee's body. He rubs it with his legs and it falls into the basket, and in this way he carries it home. Do you know why the bees want to put away the honey? They cannot get honey in the winter. So you see if they did not take care of some, they would have no food, and then what would happen to them? Why cannot they get honey in the winter? Because there are not many flowers, and it is too cold for the bees.

There are three kinds of bees in a hive—The queen, the working bee, and the drone.

The queen bee is the largest one and is the mother, and lays eggs from which the young bees come. The other bees wait on her and bring her food.

The working bees are small and do all the work. They are always very busy.

The drones are the lazy bees. They never do any work. Which should you try to be like, the working bee or the drone?

III. *Summary.*—This should be written on the board

as the lesson proceeds, and afterwards written from memory by the children.

The bee is divided into three parts—head, chest, and abdomen.

It has two large eyes and a trunk.

Its body is covered with short hairs, which catch the pollen.

It has six legs, three on each side, and on the hind one there is a hollow place called the basket.

Bees give us wax and honey, which they get from flowers.

There are three kinds of bees—the queen, the working bees, and the drones. They all live in the hive.

(To be continued.)

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Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.—DICTATED.

(1)	(2)	(3)	(4)
507	36	504	617
68	714	297	319
9	80		
70	605	207	298
836	8		
1490	1443		

STANDARD II.—DICTATED.

(1)	(2)	(3)
801	6395	12)47344
109	395	
692	2526205	3945—4

STANDARD III.

(1) Divide nine hundred thousand and one by eighteen. Ans. 50,000—1.

(2) £567 18s. 6½d + £4920 6s. 10d. + £51,783 19s. 11¾d. + £2202 16s. 0¾d. + £2867 15s. 7½d.; (given in words.) Ans. £62,342 17s. 0d.

(3) How many score sheep are there in six and a half thousand? Ans. 325.

(4) A man paid 15s. 6d. out of his week's wage, and then had 2 half-crowns, 3 florins, and 5 sixpences left; find his week's wage. Ans. £1 9s.

STANDARD IV.

(1) Divide £59,366 15s. 6d. by 97.
Ans. £612 0s. 6¾d.,—45.

(2) Subtract 4s. 10½d. from £1069 10s., then bring the remainder to half-pence. Ans. 513,243.

(3) Reduce 7 miles 1 yard to feet.
Ans. 36,963 feet.

(4) A certain house had 6 windows in it, every window had 12 panes of glass in it, and each pane contained 72 square inches. How many square feet were there in all the windows?
Ans. 36 square feet.

STANDARD V.

(1) If 15 men's wages amount to £19 3s. 10d. in one week, how many men could I pay out of £287 17s. 6d. for one week at the same rate?
Ans. 225 men.

(2) $\frac{2}{5}+\frac{1}{4}+\frac{3}{10}-\frac{5}{6}$. Ans. $\frac{7}{30}$.

(3) What would 1 fur. 13 po. 5½ ft. cost at £108 per mile? Ans. £18.

(4) If 4800 cart-loads of coal are sent from a colliery, how much is it worth at 7s. 6d. a ton, each load containing 16 cwt.? Ans. £1440.

STANDARD VI.

(1) A lady spent ⅓ of her money in one shop, ⅛ in another, and had £6 15s. left. How much had she at first? Ans. £10.

(2) Subtract $\frac{1}{2}+\frac{3}{4}+\frac{3}{7}+\frac{5}{14}$ from $15\frac{1}{9}-4\frac{1}{12}$.
Ans. $8\frac{25}{126}$.

(3) If a family of 18 persons spend £240 in 8 months, how much will a family of 48 persons spend in 16 months at the same rate?
Ans. £1280.

(4) If I lodge £360 in a bank, how long must I let it lie there at 3 per cent. to gain £37 16s.?
Ans. 3½ years.

STANDARD VII.

(1) Find the cost of insuring a cargo worth £5000 at £3 13s. 4d. per cent. Ans. £183 6s. 8d.

(2) By selling a horse for 50 guineas a dealer gains 5 per cent. What did the horse cost him?
Ans. £50.

(3) Find the discount on £564 paid 3½ years before due, at 5 per cent., simple interest.
Ans. £84.

(4) If the P. W. of a sum of money due 8 months hence at 5 per cent. be £250, what is the complete bill? Ans. £258 6s. 8d.

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Publications Received.

Adley (J.) and Co.—

The Elementary Singing Master on the Letter-Note Method. By D. Colville.
Letter-Note School Music. By D. Colville.
The Letter-Note Vocalist. Nos. 1 to 12.

Bell (G.) and Sons—

Code Standard English Grammar. Part IV. By C. P. Mason, B.A.
Italian Primer, with Exercises. By Rev. A. C. Claplin, M.A.
German Primer, with Exercises. By Rev. A. C. Claplin, M.A.

Blackie and Son—

Elementary Text Book of Physics. By J. D. Evereth, M.A., etc.
Principles of Agriculture. Book III.
Magnetism and Electricity. Part II.
Botany. Part III.
The Good-Natured Man. By Goldsmith.
Home Lesson Books. First and Second Historical Readers.
Simple Lessons in Flower Painting. Nos. 1, 2, 3, and 4. By Vere Foster.

Chambers (W. and R.)—

Elementary Science Reader. By C. McRae, M.A.
Select Poems. By Mrs. Hemans.
Milton's 'Comus.'
Campbell's Select Poems.

Gill (G.) and Sons—
Gill's New Music for the Code 1883. By R. H. McCartney. Parts I., II., and III.

Heywood (John)—
A Manual of Elementary Drill. By Ed. T. Hunt.
John Heywood's Home Lesson Book for Standard VII. By A. Gardiner.
Selections of Beautiful Poetry for Standards IV., V., and VI. By J. S. Horn.
The Child's Bible Expositor. By S. E. Scholes.

Isbister (W.), Limited—
The London Arithmetic Test Cards for Standards III., IV., V., and VI.

Johnstone, Hunter, and Co.—
The Stocking Knitter's Manual. By Mrs. G. Cupples.

Kegan Paul, Trench, and Co.—
Education and Educators. By David Kay, F.R.G.S.

Letts, Son, and Co.—
Letts's Illustrated Household Magazine. Part XII. February.

Longmans and Co.—
Longman's Magazine. No. 16. February.
Key to Manual of Short Methods in Arithmetic. By Rev. J. Hunter, M.A.
Sundry Attacks on Private Schools. By R. W. Hiley, M.A.

Murray (John)—
The Student's Hume. Parts I., II., and III.

Murby (T.)—
The Principles of Hygiene. By A. Carey, F.R.G.S.

Nelson (T.) and Sons—
The New Royal Readers for Standards I. and II.

Relfe Bros.—
Bookkeeping by Double Entry. By James Collier, B.A.

Simpkin, Marshall, and Co.—
Our Schools and Colleges. Vol. I., Boys; Vol. II., Girls. By Captain F. S. Dumaresq de Carteret-Bisson.

Smith, Elder, and Co.—
The Cornhill Magazine. No. 8, February.

Swan Sonnenschein and Co.—
Seeing and Thinking. By Schaible and Althaus.

Stanford (E.)—
Facts Around Us. By C. Lloyd Morgan, F.G.S.

The Wesleyan Methodist Sunday-School Union—
Luther Miller's Ambition. By L. Montfort.
Two Saxon Maidens. By Eliza Kerr.
Carols for Christmas Services.
The Promised Land. By T. Austin. (Sol-fa.)
The Promised Land. By T. Austin. (Staff.)

The National Society's Depository—
Sight Singing for Schools.

Unwin (T. Fisher)—
Industrial Curiosities. By A. A. Japp, LL.D.
Stops; or, How to Punctuate. By Paul Allardyce.

Ward, Lock, and Co.—
The Universal Instructor. Part XL. February.

Publications Reviewed.

The New Royal Readers. Standards I. and II. London: T. Nelson and Sons.

These new reading books have been issued with a view to meet the very latest requirements of the ever-changing Code.

The editors and publishers have, apparently, vied with each other to produce a series of readers of exceptional merit. Everything has been admirably done. New lessons, carefully graduated; new illustrations of rare artistic and educational value; faultless models of writing copies (white on black ground); and a series of 'helps' adequate enough to satisfy the most fastidious teacher or the dullest scholar, all combine to stamp these readers as amongs *the* very best yet issued. Happy the child who treads this 'New' royal road to learning.

The Student's Hume in Three Parts. Part I.—From the Earliest Period to the death of Richard III.; Part II.—Henry VII. to the Revolution; Part III.—From 1688 to the Treaty of Berlin. London: John Murray,

To criticise this well-known standard work would be a waste of time. We, therefore, simply call attention to this new, cheap, and convenient edition, in three volumes. Pupil-teachers and students in training are specially indebted to Mr. Murray for this timely issue.

Cornhill Magazine, February, 1884.

This excellent magazine maintains its high reputation. Mr. Payn's 'Literary Reminiscences' are delightful. They, alone, are well worth the modest sixpence, charged for this capital periodical.

Common Things and Elementary Science in the form of Object Lessons. By J. Hassell, A.K.C. London. Blackie and Son.

This is a most complete handbook of object lessons. The author has occupied not less than 384 pp., in which a very wide array of topics are subjected to very exhaustive treatment. Each of the hundred and fifty-three chapters allows of subdivision, in some cases into two, in other cases into at least a dozen separate lessons. These are well arranged, fully illustrated, and accompanied by valuable hints as to method. Every page in this book impresses the reader with the very thorough treatment the various topics have received. The vast accumulation of facts and the advanced character of some of the lessons will constitute a difficulty unless careful and judicious selection accompany its use. We would suggest that such topics as the consideration of the solar surface, with its spots and facula, and the theories based upon their various appearances, are beyond the range of elementary science as a class subject.

In placing the book in the hands of any teacher whom we might influence, we would say:—

(1) Here you will find all the material necessary for your lesson, and more; make a careful selection; and use the illustration given in the text.

(2) Let mental growth through the communication of this information have your first care, whilst the practical value of the matter given is not lost to view.

With these precautions we know of no better collection of lessons for use by young teachers.

Blackie's School Classics: Shakspere's 'Henry VIII.' with Notes. Blackie and Son.

Messrs Blackie here offer at a low price a well-printed edition of 'Henry VIII,' bound firmly in flexible covers. A special feature of the little volume is found in a geneaological and biographical prefix, which will greatly help the children, into whose hands it is put, to understand the the relations and actions of the characters. The Notes at the end are also useful, being sufficiently full, and on the whole clear. We fear, however, that the vocabulary employed in the notes will often be too extensive to make it safe to follow the advice of the preface, and give the children the book to study themselves. 'Aimed to prevent Papal encroachment' is language as difficult for many boys to comprehend as several of the poet's passages which are explained. Teachers intending to adopt a play of Shakspere should certainly see this edition.

French Course. First Year. By Hector Rey. London and Edinburgh: W. and R. Chambers.

We have pleasure in commending this little volume. Its simplicity in style and arrangement makes it a very suitable text-book for those beginning to study the language, and the connected and complete way in which the subject is treated will much assist the learner in acquiring a sure foundation for after-studies. The printing is excellent, and in other respects the book is well adapted for school use.

Chambers's Historical Readers. Junior English History for Standard IV. London and Edinburgh: W. and R. Chambers.

This reader gives a complete survey of English history from the first landing of Cæsar to the present day. Details are, of course, as a rule, omitted, but those important features which are enlarged upon are treated in a bright and interesting manner, which cannot fail to bring the book into favour among its users. The illustrations and maps are numerous and good, and the volume seems adapted in every way for the use of Standard IV.

The English Constitution and Government. By Sheldon Amos, M.A. London: Longmans.

The dedication of this volume to the Emperor of Japan tells us it was originally prepared for the Commissioners of his Imperial Majesty; and, no doubt, the public owe a good deal to this fact, for the lucidity and thoroughness of the work. The author, as perhaps the leading professor of this difficult subject in our midst, was no doubt appealed to, to assist these gentlemen in studying our nation and her customs, etc., for the benefit of their own people, who a few years ago began to make such important changes in their government, currency, and, in fact, manner of life. Had this book been prepared for Englishmen, or even English boys, we strongly expect the author would have taken for granted as already known, and therefore unnecessary for insertion, many things which we find clearly expressed here. Every one knows that to answer a question really well, we must assume perfect ignorance on the part of the questioner; and we feel confident that it is this assumption—nay, perhaps conviction—of ignorance on the part of these foreigners that has produced this really almost faultless work. Most mathematicians think that everybody understands the nature of the impossible problem of 'squaring a circle,' but we doubt if one out of ten could even tell us what the problem depends on, and not three times that number even what it is; so, too, most writers on constitutional history would, we believe, assume a knowledge of many things which are carefully explained in the book before us, and omit them as unnecessary. At the beginning of the volume there are careful definitions of such terms as 'constitution,' 'law,' 'executive,' and 'right,' which ought to be well studied, and at the conclusion there are some valuable appendices, giving entire translations of the 'Magna Charta,' 'Confirmatio cartarum,' etc., with copies of other well-known bulwarks of British freedom, but known to the masses in very little more than name. The index at the end is very valuable, being exceptionally full. Every schoolmaster ought to have a copy of the book, as he would find it an invaluable adjunct to every lesson he might give in the history of our country.

Longman's Magazine. February, 1884.

This is an exceptionally good number of this well-known magazine. Mr. W. Clark Russell continues his admirable sea story, entitled 'Jack's Courtship; a Sailor's Yarn of Love and Shipwreck.' Among the other contributors are Richard Jeffries, D. Christie Murray, the author of the 'Recreations of a Country Parson,' and Mrs. Oliphant. We strongly advise our readers to 'take in' this excellent monthly.

The Standard Author Readers. (Complete Series.) London: Griffith and Farran.

We are sure that teachers—and especially *infant* teachers—will thank the publishers of this excellent series of reading-books. It is without a doubt one of the best ever produced, either for elementary or secondary schools. The editor has been singularly successful in placing within reach of the young some of the purest gems of English literature. The paper, printing, illustrations, and binding are alike excellent. We trust that teachers, before finally selecting their reading-books, will send for a full prospectus of 'The Standard Author Readers' to Messrs. Griffith and Farran, whom we heartily congratulate on the publication of these admirable volumes.

An Explanatory Arithmetic. By G. Eastcott Spickernell. London: Simpkin, Marshall and Co.

The real *raison d'être* of this book is, we confess, somewhat hard to find. Few schoolmasters are satisfied with the text-books they use; hence the enormous multiplication of these elementary treatises. The author, however, promises us in his preface such an amount of explanation that a master will be scarcely required. If the end and aim of arithmetic were to enable a boy to pass an examination, and to perform the very few practical questions that may be brought before him in life, we dare say the book under question would answer the purpose. But our children go to school to be educated, and arithmetic is the one educational subject, above all others, that we expect to be given to them; and we very much fear that if any one were to try and learn the science of arithmetic from this little book he would neither go very far, nor be lured on to a deeper and more exhaustive view of the subject. Some of the rules are given without a word of explanation, as in the case of extracting the square and cube root; the author almost implies that the processes employed are not able to be understood without a knowledge of algebra. This, we contend, is not the case, as a picture or two of such a nature as the author himself has given us, to show the method of finding the side, area, or contents of a rectangular surface or solid, would explain them both immediately.

The examples are numerous, and seem well arranged; the answers being printed at the end of the book.

Johnston's Standard Wall-Map of the Britis h Empire. London: A. Johnston.

We have pleasure in directing the attention of teachers to this excellent production, the importance of which for everyday educational purposes can hardly be over-estimated. We have here a series of twenty-eight maps, embracing all our colonial and foreign possessions, from the mile-long Helgoland to the immense expanses of India, Australia, and British North America—each map nicely coloured and showing as much detail as is compatible with clearness and efficacy in class work. There is probably no map—save that of our native isles—which can show a greater claim to be displayed on the walls of a British school than one of the British Empire, and the map now under consideration has so many good points that it only needs to be known to be properly appreciated. It is remarkably well brought up to date, and the only improvement we can suggest is that some means of comparing the relative sizes of the various parts of the world delineated should be given, either by simply stating the number of square miles under British rule in each map, or else by marking off a square, to represent the area, in the top right-hand corner of each compartment, the same scale being employed in each case.

Useful Trees. A series of six, mounted and coloured. London: A. Johnston.

This series comprises the Oak, the Elm, the Fir, the Beech, the Ash, and the Mahogany, and as the drawings are well done and effectively coloured, they will form very valuable adjuncts to the object lessons.

The size of each card is 21 inches by 26 inches, and on the back is printed a description of the tree represented. This is a good feature, and will save the teacher considerable trouble in research.

The Proper Psalms for Certain Days. With Notes by the Rev. J. J. Scott, M.A. London: National Society's Depository.

We have pleasure in recommending this little manual to the attention of those of our readers who desire to possess an interesting explanatory guide to the due understanding of this part of the Holy Scriptures. The book has evidently been prepared with great care, and the copious notes and remarks are thorough, without being too erudite. We may add that they were originally delivered and published as part of a course of Lectures to Pupil Teachers in the diocese of Manchester.

Shakspere's 'King Henry IV.' The Second Part. Prepared and annotated for school use by Charlotte M. Yonge. London: National Society's Depository.

Miss Yonge's undoubted power as a writer of good healthy English, exactly fitted for English children, is a guarantee that any work, such as the one now before us, which has been prepared by her for school use will afford little ground for complaint. Nor does this example of her work fall below the high standard we should naturally expect. For the notes are carefully adapted for youthful use, the book is printed in good legible type, and the Introduction and Summary of the play, with which the volume commences, are written in the interesting, effective style so characteristic of the author of 'The Heir of Redclyffe.'

Third Paragon Reader: Standard III. Manchester and London: John Heywood.

This reader upholds the high character of those of the same series which have preceded it. The subject-matter is interesting, and the language throughout seems well adapted to the capacities of the Standard for which it is intended. The pages are enlivened with some well chosen woodcuts, and the book has been carefully attended to in the matter of paper and binding.

The Parts of Speech. By William B. Irvine. Relfe Brothers.

This is a useful little book for young children, illustrated by numerous examples. Towards the end of the book the analysis of the simple sentence is given, and when the pupil has advanced to conjunctions the different subordinate clauses are explained in an easy and lucid manner. The manual is wonderfully printed, and, withal, very cheap.

Guide for the Pronunciation of the French Language. A Synopsis of Appropriate Instructions. By J. G. Rousseau, Professor of French at the Forest School, Walthamstow. London: Dulau and Co.

Although we do not believe in the possibility of an English person acquiring anything like a good pronunciation of French words from written instructions, we have pleasure in saying that the guide tabulated by M. Rousseau seems as practical as any we have come across, and in the absence of the *oral* instruction, which in our opinion is absolutely necessary, may perhaps be of as much assistance as such written instruction can be.

Woods and Forests. No. 2. London: W. Robinson.

This well got-up periodical is, we believe, the first which has ever been brought out weekly, at least in England, in connection with the 'tree-growing' interest. Whether there exists a sufficiently numerous *clientèle* to render a publication of this sort a success we have no means of judging, nor indeed is it in our province to do so. Suffice it to say, that the intrinsic merits of *Woods and Forests* deserve success, and the paper will, from the sound technical information contained in its columns on all matters connected with forestry and arboriculture, prove a weekly boon to those interested in such matters. The illustrations are well up to the mark.

ERRATA.—By inadvertence two errors occurred in Mr. Winch's 'My Scholarship Answers,' which appeared in our last month's issue. In the working of Question 2 in the Arithmetic Paper (page 631) the number of oranges has been taken as 350 instead of 250; and in Algebra, Question 7 (page 634), the factors of $x^2 - x - 12$ should be $(x-4)(x+3)$ instead of $(x-6)(x+5)$.

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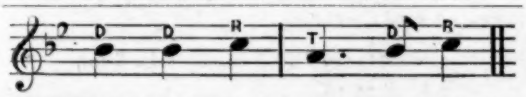

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